

# Evaluation, Measurement, and Verification of the California Investor Owned Utilities' Embedded Energy in Water Pilot Programs

RFP # 07 PS 5734

A Proposal to the  
California Public Utilities  
Commission

**ECONorthwest**

ECONOMICS • FINANCE • PLANNING

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March 13, 2008



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# Section 1: Team Presentation Cover Sheet

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## **RFP No. 07 PS 5734**

*Contractors to Conduct Evaluation, Measurement, and Verification of the California Investor Owned Utilities' Embedded Energy in Water Pilot Programs*

### **Prime Contractor:**

ECONorthwest  
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Portland, OR 97204  
(503) 222-6060

Proposal contact: Dr. Stephen Grover  
[grover@portland.econw.com](mailto:grover@portland.econw.com)

### **Subcontractors:**

SBW Consulting, Inc  
Pacific Institute  
Population Research Systems  
SDV / ACCI (DVBE)



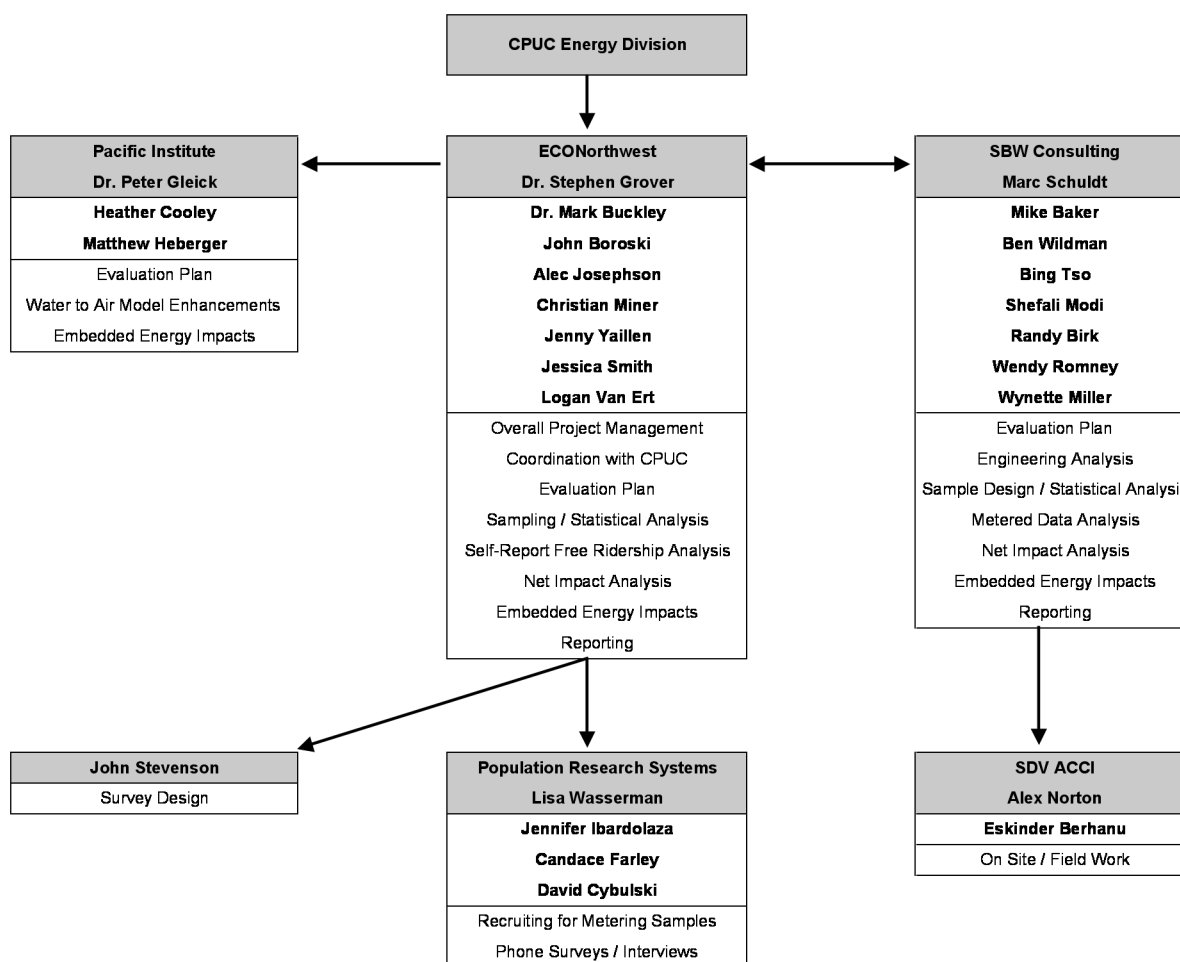
# Section 2: Evaluation Team Composition

## ORGANIZATION CHART

The organization chart below identifies each firm and the general lines of responsibility. Areas of major analysis activity for each firm are also listed. Additional detail on individual staff assignments is provided later in this section.

Please note that while ECONorthwest is the prime contractor, this is very much a joint venture between ECONorthwest and SBW Consulting. We believe that this organizational structure is one of the strengths of our team, as ECONorthwest is not the prime contractor for any of the CPUC energy impact evaluations and therefore has the resources available to manage the Embedded Energy evaluation. As discussed below, both ECONorthwest and SBW are intimately familiar with the energy impact Evaluation Protocols and will be applying these methods as much as possible to the issues of embedded energy savings in water conservation.

**ECONorthwest Evaluation Team Organization Chart**



## **FIRM DESCRIPTIONS**

### **ECONORTHWEST**

ECONorthwest (ECO) specializes in the economic and financial analysis of public policy. ECO has analyzed energy, transportation, land-use, and growth-management issues in the Pacific Northwest for more than 30 years and has completed over 1,500 projects in these areas. ECONorthwest employs 50 economists, planners, and policy analysts. The firm has offices in Portland, OR and Eugene, OR (corporate headquarters). ECONorthwest has developed expertise in energy program evaluation through numerous evaluations of commercial and residential efficiency programs in California and throughout the U.S. and Canada. These evaluations have ranged from rigorous impact evaluations (utilizing billing regressions, self-selection models, and discrete choice analysis) to more qualitative process evaluations of market transformation programs that require estimating market effects resulting from program activities.

In addition to our California evaluation experience, ECONorthwest was hired by the CPUC Office of Ratepayer Advocates from 1995 to 2003 to verify all of the evaluation analysis used to support the DSM program earnings claims for all of the electric utilities in California. Each year, this has involved reviewing 20 to 30 separate energy conservation programs and often required re-estimating the billing regression models used by the utilities to determine net impacts. ECO's work on this project has had substantial implications for California utilities, policy makers, and ratepayers and the results of our analysis can impact utility earnings claims by tens of millions of dollars. In addition, our recommendations influenced the procedures set by California in subsequent years for estimating the energy savings associated with all electric utility DSM programs within the state.

### **SBW CONSULTING, INC. (SBW)**

SBW Consulting, Inc. (SBW), located in Bellevue, Washington, is an engineering consulting and program management firm. SBW was established in 1990 and is dedicated to helping gas, electric, and water utilities design, implement, and evaluate their customer efficiency programs. Our talented engineering staff has extensive experience with many types of programs ranging from direct-installation of simple devices, such as efficient spray valves for food service establishments, to programs requiring complex technical services for large commercial or industrial facilities. Our engineers are well versed in capital and operations and maintenance strategies for lighting, compressed air, boilers, refrigeration, HVAC, steam/water/air distribution, and wastewater treatment. SBW is owned, and was founded by, three of its senior engineers. They have been providing energy efficiency services to clients throughout the nation for more than 25 years.

SBW has conducted many water efficiency studies in which the water and energy consumption of end use devices were directly metered. These include studies of showerheads, faucet aerators, toilets, urinals, pre-rinse spray valves, ice machines, residential horizontal-axis washing machines, commercial coin-op washing machines, ice machines, and irrigation systems. In addition, we have metered water and electrical use for process and HVAC systems in commercial and industrial facilities, including wastewater treatment facilities. Through these studies, our engineering staff has gained extensive knowledge of the real operational performance of many water efficiency technologies. We recently completed a water conservation potential assessment for the Tacoma Water agency that fully exploited more than 15 years of this experience with water and energy studies. A member of our senior engineering staff (Ben Wildman) also has in-depth experience with wastewater treatment facilities and has conducted energy efficiency audits and evaluation research for both water treatment and wastewater treatment facilities.



## **PACIFIC INSTITUTE**

The Pacific Institute is an independent non-profit organization founded in 1987 and is considered the leading independent voice analyzing long-term water issues from the perspective of science and policy.

The Pacific Institute has worked on global and regional water issues for over twenty years, with a strong focus on sustainable use of water in California. In the early 1990s, the Institute published the first comprehensive long-term water plan for California that focused on sustainable and efficient water use scenarios, and included a discussion of the impacts of climate change on water (“California Water 2020: A Sustainable Vision”). The Institute has prepared a series of assessments of water-use efficiency potential for the state as a whole, and for individual water agencies and watersheds around the country, including Mammoth Creek, the Santa Ynez basin, the city of Atlanta, Las Vegas, and others. The Institute’s work includes evaluating energy savings associated with residential water programs, the energy implications of desalination, water transfers, treatment and processing, and end use. Our analysis “Energy Down the Drain” developed a set of case studies on the water-energy nexus that was key to later work prepared by the California Energy Commission.

The Institute also addresses the critical issue of climate change. Dr. Peter Gleick created the first regional hydrologic model to assess the effects of a range of climate scenarios on water resources in northern California. This research, in the late 1980s, identified the potential for dramatic changes in snowfall and snowmelt patterns, along with changes in the timing of runoff in major rivers. In 1990, the Institute published the first analysis of the cost of protecting San Francisco Bay from climate-induced sea-level rise, including an initial look at ecosystem impacts in the Bay. In the mid-1990s, the Pacific Institute completed a major assessment of the potential effects of climate change on the Colorado River basin and in 2000, directed the research and writing for the water sector chapter of the U.S. national climate change assessment (“Water: The Potential Consequences of Climate Variability and Change for the Water Resources of the United States”).

## **POPULATION RESEARCH SYSTEMS**

Population Research Systems (PRS), a subsidiary of Freeman, Sullivan & Co., provides expert research design, data collection, statistical and economic analysis, and modeling to support corporate decision-making, public policy development and applied research in population demographics, health risk, and consumer choice modeling.

PRS specializes in carrying out scientifically robust statistical surveys using in-person, telephone, mail and web-based (Internet) techniques. All of our data collection activities take place under direct control of our skilled project management, and no aspect of the work is subcontracted out of the company. In addition to its field data collection teams, PRS maintains a 38-station Computer-Assisted Telephone Interviewing (CATI) facility at its San Francisco office. The laboratory routinely collects data in English, Spanish, Vietnamese, and Chinese. PRS has extensive expertise collecting data from hard-to-reach populations including business decision makers, executives, small geographical areas (e.g., neighborhoods), low-income populations, non-English speaking populations, and relatively rare ethnic groups. Additional data collection methodologies – qualitative and quantitative – include field interviews, one-on-one interviews, web-based surveys, postal mail, mixed and multi-mode methodologies.

During its 20 years in business, PRS has conducted hundreds of scientific surveys throughout the U.S. In that time we have worked with most of the major utilities in the U.S., including all of the major California electric utilities. PRS researchers represent a wide range of academic disciplines including sociology, economics, psychology, and public health. PRS project management personnel are exceptionally well

qualified academically. All have attained the level of master's degree and most are Ph.D.s in subject matter areas that routinely use scientific surveying in research.

## **SDV / ACCI (DVBE)**

ACCI West was founded in 1986 as a consortium of professionals and has grown to a company owned by Jerry Metz, a service-disabled Marine veteran. The basic concept of SDV/ACCI is to provide clients with cross-discipline engineering and administrative project or task services at the client location, on site, and/or at ACCI premises.

SDV/ACCI was incorporated in February 1991. Since then, SDV/ACCI has been supporting Primes in a wide variety of roles and for a wide variety of state departments, including DGS, Caltrans, ARB, DSA, CEC/CPUC, CIWMB, local school districts, DWR, OSHPD, CSUs, etc. SDV/ACCI has been involved in energy-related projects since the mid-90s, and has participated in over 30 CEC and CPUC funded projects, including the CPUC's current 2006-08 energy impact evaluations.

## **RELEVANT STUDIES**

### **ECONORTHWEST**

**Impact Evaluation of a Commercial Gas DSM Program.** For Southern California Gas (SCG), ECONorthwest conducted the 2004-05 impact evaluation of the Nonresidential Financial Incentives Program that targets small and medium gas customers. Through the program, financial incentives are provided to replace existing gas equipment or to improve industrial processes to reduce gas consumption. The Commercial Food Service Equipment Rebate element provides a list of approved products eligible for rebates. The Nonresidential Equipment Replacement provides incentives for "kind-for-kind" replacement of old, inefficient commercial or industrial end-use, gas-fired technology with higher efficiency alternatives. The Nonresidential Energy Conservation incentive element provides qualified customers with a financial incentive to implement energy efficient retrofits, industrial process modernizations, or industrial process energy efficiency improvements. Measures covered by this program include food service equipment, industrial furnaces, kilns, ovens, dryers, industrial washers, incinerators, thermal, heat recovery applications, and process steam improvements.

Net program impacts were estimated using a combination of a billing regression and self-reported free ridership estimates. For the Food Service component, a sample of nonparticipants was used as the project baseline. In addition to the billing model, the evaluation also involved conducting customer phone surveys in support of a process evaluation of program delivery, on-site audits to verify equipment installation, and a self-report free ridership analysis. The evaluation also included a detailed review of the data tracking procedures and the savings calculations used to develop the initial savings estimates by SCG. The review of the engineering analysis behind a sample of projects was in-depth and SCG utilized our findings to redo their work papers for some measures. In addition to presenting net realized impacts, the final evaluation report presented recommendations for program improvements and procedures that needed to be adopted by SCG to improve the evaluability of the program. Project duration: 7/2004 – 7/2006.

Client Reference: Rob Rubin, San Diego Gas and Electric, 8335 Century Park Court, San Diego, Ca, 92123-1593, (858) 654-1244, [rrubin@semprautilities.com](mailto:rrubin@semprautilities.com). Budget: \$146,225

**Statewide Emerging Technologies Program Evaluation.** ECONorthwest evaluated the 2004-05 Statewide Emerging Technologies Program under the direction of SCE. Evaluation activities included

developing a logic model and program theory for the program. Once this was completed, the logic model and program theory were tested by selecting a sample of technology assessments for use as case studies. These case studies were used to track program progress and demonstrate the underlying program logic based on key progress indicators developed by the evaluation for each linkage in the logic model. The case study process was designed to be a scaled-down version of the “aggregate analysis” required in the upcoming evaluation, as described in the Emerging Technology Protocol.

Additional evaluation activities included a process evaluation that examined the technology selection process, interaction with the energy efficiency programs at each utility, and communications across utilities and with other stakeholder groups (CEC, CPUC, PIER). The evaluation was designed to be a test-run of the 2006-08 Evaluation Protocols. The final evaluation report provided detailed recommendations on data tracking to facilitate easier aggregate analysis and progress tracking in future evaluations, and research issues that should be addressed in future evaluations. Project duration: 3/2006 – 7/2007.

Client Reference: Carol Yin, Southern California Edison, 6040A N. Irwindale Ave, Irwindale, CA, 91702, (626) 812-7561, [carol.yin@sce.com](mailto:carol.yin@sce.com). Budget: \$193,160

## **SBW CONSULTING**

**Impact and Process Evaluation of the 2001 Commercial Water Conservation Programs, prepared for Seattle Public Utilities.** This report documents our evaluation of the Water Smart Technology program. This program offers specific incentives for a number of technologies, such as efficient coin-op washing machines, efficient toilets and urinals, and replacement of water-cooled ice machines with air-cooled ice machines. In addition, custom incentives are available for other types of water savings measures.

Measure-specific evaluation plans were developed for a sample of 25 measures randomly selected from those installed under the program in 2001 and early 2002. Each plan documented the data collection and analysis methodology that was used to compute separate estimates of annual water consumption for the baseline and efficient conditions. Water savings from each efficiency improvement were computed as the difference between the annual estimates of baseline and efficient consumption, after adjustment was made for variations in seasonal performance, production variations, or other factors that influenced water consumption but were not related to the performance of the measure.

Interviews with participant decision-makers were conducted for each of the 25 measures. Data from these interviews were used to evaluate the impact of free-ridership and spillover, ultimately resulting in a net-to-gross ratio (NTGR) for each measure. The NTGR was used to estimate net savings for each measure and subsequently for each water efficiency technology, as well as for the program as a whole.

Client Reference: Tim Skeel, [Tim.Skeel@ci.seattle.wa.us](mailto:Tim.Skeel@ci.seattle.wa.us), Seattle Public Utilities, 700 5th Ave., Seattle, WA 98121-4018, (206) 386-9084. Budget: \$195,000

**Impact And Process Evaluation Final Report For California Urban Water Conservation Council 2004-5 Pre-Rinse Spray Valve Installation Program (Phase 2).** This evaluation relied on a variety of techniques and data sources to assess the energy savings and effectiveness of the program. These included short-term metering, one-time measurements, observations, and interviews at installation sites, as well as telephone surveys. We randomly selected four percent of the spray head installations (659 of them) for site visits. For all selected installations, we observed whether the efficient head was still in place, and verified that the program had indeed visited the site. At 195 of these installations, we also measured flow rates and water temperatures, and interviewed staff about satisfaction with the valves.

Lastly, at 29 installations, we installed flow meters to record water use for over a month with the efficient head. At 19 of these, we also recorded comparable water use with the original head.

The evaluation team also conducted 12 in-depth interviews with program managers and installers, and spray head manufacturers and distributors. We developed a protocol for these interviews, and analyzed the information obtained through them to assess program effectiveness and areas for improvement, as well as the program net-to-gross ratio (that is, the rate at which program participants might have installed efficient spray heads even had the program not existed). Furthermore, we added a follow-up process evaluation to determine why quality control procedures broke down, resulting in discrepancies between reported and actual spray head installations. This task featured in-depth interviews with four individuals involved with the program.

Client Reference: John Koeller, Koeller and Company, [koeller@earthlink.net](mailto:koeller@earthlink.net), California Urban Water Conservation Council, 455 Capitol Mall #703, Sacramento, CA 95814, (714) 777-2744. Budget: \$200,000.

## **PACIFIC INSTITUTE**

**“Quantifying Commercial, Industrial, Institutional Demand Side Management Potential.” Funded by the Department of Water Resources (Agreement 46002001674). Project completed in 2001.**

**Project budget of \$72,500.** In 2001, the Pacific Institute was awarded a grant in the amount of \$72,500 from the CALFED Water Use Efficiency Program to evaluate water demand for the commercial, industrial, and institutional sector (CII). The objectives of the project were to (1) estimate current CII demand by sector and end-use, (2) identify demand management alternatives, and (3) quantify water savings based on each alternative for selected industries and regions of California. Based on these results, we prepared a series of policy recommendations for water conservation and identified data deficiencies. The results of this study were included in the highly regarded report entitled “Waste Not, Want Not: The Potential for Urban Water Conservation in California.” We also held meetings with the Department of Water Resources (DWR) to discuss the major findings of this project.

During Phase 1, we analyzed both raw DWR data on industrial water use and previous studies on commercial and institutional water use to produce statewide water use coefficients by SIC code. We then combined employment data and water use coefficients to estimate volumetric water use by SIC code. During Phases 2 and 3, we identified demand management alternatives and conducted a cost-benefit analysis of each alternative. By comparing the price of conservation and the price of water throughout the state, we produced a minimum, state-level aggregate estimate of cost-effective water conservation. We then estimated future CII water use under three scenarios: (1) business as usual, (2) adoption of all cost-effective measures, and (3) maximum conservation technology penetration. We then compared water use in each scenario and generated an estimate of potential water savings through the adoption of water conservation measures.

Client Reference: Marsha Prillwitz, California Department of Water Resources, Office of Water Use Efficiency, 1416 Ninth Street, Room 338, Sacramento, California 95814, (916) 327-1645.

**“Energy Down The Drain.” Funded by The William and Flora Hewlett Foundation and the Compton Foundation, Inc. Project completed in 2004. Project budget of \$80,000.** This report documents our work evaluating the connections between energy and water in the Western U.S. The report quantifies the energy intensity of water for five stages of the water use cycle: source and conveyance, treatment, distribution, end use, and wastewater treatment. The source and conveyance category, for example, contains the energy required for the extraction of raw water from its source and conveyance of water to the site of treatment; it includes total water, energy use, and energy intensity estimates associated

with each of the major water projects in California, groundwater extraction, brackish and seawater desalination, ocean towed bags, and recycled water.

Case studies are evaluated for San Diego County, Westlands Water District, and the Columbia River Basin. Data on water and energy use for each of these case studies was compiled from a variety of sources, including local water districts and previously published reports.

Results from this project were included in the Pacific Institute's Water to Air model, an Excel-based model that allows water managers to evaluate the energy and air quality impacts of various water management scenarios.

Client Reference: William Slaughter, Goldsmith Foundation, 375 Park Avenue, New York, NY 10152, (212) 319-8700, [slaughter@ballardspahr.com](mailto:slaughter@ballardspahr.com).

## **POPULATION RESEARCH SYSTEMS**

### **Park Water Company Customer Survey (Completed 12/2004)**

The project goal of the Park Water Company Customer Survey was to better understand customers' needs and preferences in the Los Angeles County portion of the Park Water Company's service territory and to facilitate the Park Water Company's customized communication with its customers. Topics explored included information needs, language preference, payment method preference, as well as perception of the company. 387 interviews were completed in English and Spanish. We collaborated with Park Water Company in creating the telephone interview, analyzing data, and developing reports and presentations for its Board.

Client Reference: Jackie Glover, Senior Public Affairs Specialist, Park Water Company, 9750 Washburn Rd, PO Box 7002, Downey, CA 90241-7002, (562) 923-0711, [jglover@parkwater.com](mailto:jglover@parkwater.com). Budget: \$9,998

### **Household and Commercial Study for the Transportation Fuel Demand Forecast for the California Energy Commission (Completed 3/2008).**

This project involved a mixed-mode survey design of households and commercial fleet vehicle operators to assess current vehicle ownership, the factors inherent to purchasing a new vehicle, the likelihood of purchasing an alternative fuel vehicle or other advanced technology vehicle, and firmographic/demographic information. The survey was conducted in two stages. Stage 1 involved 4,110 randomly selected household participants and 1,885 randomly selected commercial participants, who were surveyed by telephone. Data was collected on current vehicle ownership by number, class and model year of vehicles, purchase and disposal behavior in regard to vehicles and behaviors related to vehicle usage. The goal of the data collection was to assess the current vehicle fleet in the state and to project future fleet composition and respective fuel needs. Information from the first stage was used to determine eligibility for the second stage of the project. A total of 2,331 households and 1,128 businesses were identified as ineligible and were invited to participate in Stage 2.

Stage 2 of the project consisted of a tailored preference choice experimental task, which determined the trade-offs respondents were willing to make among characteristics of alternatives offered to them. Respondents were mailed an invitation letter, a dollar coin as a pre-incentive, and a personalized choice exercise survey that contained the collected key variables from the phone interview in Stage 1. The survey was completed either by phone, mail, or web/internet, based on preference and respondents received a \$20 (\$25 for businesses) incentive. Overall 1,589 households and 731 businesses completed the follow-up Stage 2 survey for a response rate of 68 percent and 65 percent, respectively.

Client Reference: Kathleen Gaffney, KEMA, 492 Ninth St., Ste. 220, Oakland, CA 94612, (510) 891-0446, [kgaffney@kema-xenergy.com](mailto:kgaffney@kema-xenergy.com). Budget: \$422,173

## HOW OUR TEAM MEETS THE NEEDS OF THIS EVALUATION EFFORT

Our team has been assembled to provide expertise in both energy and water conservation issues. In particular, both ECONorthwest and SBW are very involved in the current energy impact evaluations being conducted by the CPUC, and we plan on adapting these state-of-the-art methods for use in the water conservation programs and developing estimates of embedded energy impacts. In addition to ECONorthwest and SBW, we have enlisted the help of John Stevenson and Population Research Systems to ensure that all survey work follows the current best practices in the industry. We have also structured our team so that ECONorthwest will handle the administrative and project management function, as ECONorthwest is not currently performing this role for any of the other large CPUC energy impact studies.

We have also included Pacific Institute on our team, which provides unparalleled expertise with the Water to Air model, which is widely used to estimate embedded energy impacts from water conservation. This expertise will allow us to enhance this model to provide additional time and regional dimensions for the embedded savings estimates. These enhancements will be done so that the results of the Pilot program evaluations can be integrated directly into the upcoming Statewide study and serve as a module in the E3 calculator for estimating program cost effectiveness.

Finally, both ECONorthwest and SBW are intimately familiar with the current energy impact Evaluation Protocols and will follow these as much as possible for the Pilot program evaluations. The result will be rigorous estimates of gross and net program impacts and embedded energy savings for each of the Pilot programs. One of the key goals of this evaluation is to develop a new set of analysis guidelines for future evaluations, and our proposed adherence to the existing energy evaluation Protocols will lay the groundwork for meeting this objective. Our proposed evaluation approach is designed to provide specific recommendations that can serve as analysis guidelines for future water conservation program evaluations where gross and net embedded energy savings impacts are being estimated.

## TEAM MEMBER AREAS OF RESPONSIBILITIES

### ECONORTHWEST

**Dr. Stephen Grover** will be the overall project manager for this evaluation and therefore will oversee virtually all evaluation tasks. Specific responsibilities include:

- Overall project management and interface with CPUC.
- Management and quality control for all subcontractors and all evaluation work products and deliverables.
- Development of the evaluation plan.
- Coordination of Water to Air Model revisions with the Statewide study and E3 calculator
- Manage all major evaluation analysis components
- Primary author of the evaluation report

**Dr. Mark Buckley** will assist Dr. Grover with analyzing water issues and be involved in the following tasks:

- Assist with developing the evaluation plan.
- Provide input in the proposed enhancements to the Water to Air model.



- Analysis of water and energy impacts at the water supply and waste water treatment agencies
- Analysis of embedded energy impacts.

**John Boroski** will help Dr. Grover coordinate and manage evaluation tasks. His role will also include involvement in the following tasks:

- Net and gross impact analysis for individual programs and measures
- Self-report free ridership analysis
- Analysis of embedded energy impacts.
- Assist with writing the final report

**Christian Miner** will assist with data management and statistical analysis and will help with supervising staff on similar tasks. This will involve the following responsibilities:

- Statistical analysis and regressions for those programs where billing analysis is used to estimate impacts
- Net and gross impact analysis for individual programs and measures
- Self-report free ridership analysis for individual Pilot programs and measures
- Metered and billing data management

**Alec Josephson** will assist with data management and statistical analysis and will help with supervising staff on similar tasks. He will work on the following:

- Statistical analysis and regressions for those programs where billing analysis is used to estimate impacts
- Net and gross impact analysis for individual programs and measures
- Self-report free ridership analysis for individual Pilot programs and measures
- Metered and billing data management

**Jenny Yaillen** will be one of the primary analysts on this project and will have the following responsibilities:

- Statistical analysis and regressions for those programs where billing analysis is used to estimate impacts
- Net and gross impact analysis for individual programs and measures
- Self-report free ridership analysis for individual Pilot programs and measures
- Metered and billing data management

**Jessica Smith** will be one of the primary analysts on this project and will have the following responsibilities:

- Statistical analysis and regressions for those programs where billing analysis is used to estimate impacts
- Net and gross impact analysis for individual programs and measures
- Self-report free ridership analysis for individual Pilot programs and measures
- Survey data management and analysis

**Logan Van Ert** will work as an analyst on this project and be involved in the following evaluation tasks:

- Statistical analysis and regressions for those programs where billing analysis is used to estimate impacts
- Net and gross impact analysis for individual programs and measures
- Self-report free ridership analysis

**John Stevenson** will be the lead on designing all phone survey instruments and in-depth interview guides. He will also assist with interview and recruiting for on-site samples as needed.

## **SBW CONSULTING**

**Marc Schuldt** will be SBW's project manager for this study. In this role he will have the following responsibilities:

- Primary interface with ECONorthwest
- Preparation and ongoing management of all SBW project milestones and project budget
- Assignment of project responsibilities to SBW project staff and ongoing supervision of SBW project staff.
- Quality control review of all major SBW deliverables from the project.
- Manage and have significant contributions to the development of the evaluation plan.
- Technical consultation with SBW and subcontractor staffs on engineering issues that arise during data collection and savings analysis of the sampled sites.

**Michael Baker** will be the research planning consultant. In this role he will have the following responsibilities:

- Assist ECONorthwest with the development of program-specific EM&V plans, including methods for estimating embedded energy.
- Advise on the development of data collection instruments and procedures.
- Advise on the development and calibration of models for estimating embedded energy.

**Ben Wildman** will have the following responsibilities:

- Quality control reviews for site-specific impact evaluation plans and reports.
- Develop site-specific M&V plans that detail the data collection and analysis for each measure at a sampled site.
- Conduct data collection (data loggers, EMCS trend logs, occupant and operator interviews), both pre and post, as needed to complete the impact evaluations for projects involving either complex measures or complex facilities.
- Conduct water and energy savings analysis for projects involving either complex measures or complex facilities.
- Assist in the development and calibration of embedded energy estimation models, especially as they pertain to energy used water or waste water treatment facilities.
- Assist in the development of the impact evaluation reports for each of the water efficiency pilot programs.

**Bing Tso** will have the following responsibilities:

- Quality control reviews for site-specific impact evaluation plans and reports.
- Develop site-specific M&V plans that detail the data collection and analysis for each measure at a sampled site.
- Conduct data collection (data loggers, EMCS trend logs, occupant and operator interviews), both pre and post, as needed to complete the impact evaluations for projects involving either complex measures or complex facilities.
- Conduct water and energy savings analysis for projects involving either complex measures or complex facilities.
- Assist in the development and calibration of embedded energy estimation models, especially as they pertain to energy used water or waste water treatment facilities.

**Shefali Modi** will have the following responsibilities:



- Quality control reviews for site-specific impact evaluation plans and reports.
- Develop site-specific M&V plans that detail the data collection and analysis for each measure at a sampled site.
- Conduct data collection (data loggers, EMCS trend logs, occupant and operator interviews), both pre and post, as needed to complete the impact evaluations for projects involving either complex measures or complex facilities.
- Conduct water and energy savings analysis for projects involving either complex measures or complex facilities.
- Assist in the development and calibration of embedded energy estimation models, especially as they pertain to energy used water or waste water treatment facilities.

**Randy Birk** will have the following responsibilities:

- Specification and preparation of appropriate metering equipment. Assist with the development of the EM&V plan for each of the programs in this group.
- Install metering equipment
- Conduct data collection (data loggers, EMCS trend logs, occupant and operator interviews), both pre and post, as needed to complete the impact evaluations for projects involving either complex measures or complex facilities.
- Conduct water and energy savings analysis for projects involving either complex measures or complex facilities.

**Wendy Romney** will have the following responsibilities:

- Logistical support for field engineering staff.
- Data entry and data processing.

**Wynette Miller** will have the following responsibilities:

- Logistical support for field engineering staff.
- Data entry and data processing.

## **PACIFIC INSTITUTE**

**Dr. Peter Gleick** will manage the Pacific Institute's portion of this evaluation and will have the following responsibilities:

- Primary interface with ECONorthwest and SBW Consulting
- Preparation and ongoing management of all Pacific Institute project milestones
- Preparation and ongoing management of the Pacific Institute project budget
- Assignment of project responsibilities to Pacific Institute project staff and ongoing supervision of Pacific Institute project staff.
- Quality control review of all major Pacific Institute deliverables from the project.
- Technical consultation with Pacific Institute staff on project design and implementation.

**Heather Cooley** will have the following responsibilities:

- Assist with project design.
- Collect relevant data from water and energy utilities
- Conduct water and energy analysis for water supply, distribution, and treatment facilities.
- Conduct QA/QC on water and energy analysis model

**Matthew Heberger** will have the following responsibilities:

- Assist with project design.
- Collect relevant data from water and energy utilities
- Conduct water and energy analysis for water supply, distribution, and treatment facilities.
- Develop water and energy analysis model

## **POPULATION RESEARCH SYSTEMS**

**Lisa Wasserman** will have the following responsibilities:

- Manage all of PRS data collection tasks
- Interface with ECONorthwest
- Provide input on the survey instrument design and recruitment scripts
- Assist with phone surveys and in-depth interviews
- Assist with on-site recruitment for metering sample

**Jennifer Ibardolaza** will have the following responsibilities:

- Provide input on the survey instrument design and recruitment scripts
- Assist with phone surveys and in-depth interviews
- Assist with on-site recruitment for metering sample

**Candace Farley** will have the following responsibilities:

- Conduct phone surveys and in-depth interviews
- Conduct on-site recruitment for metering sample

**David Cybulski** will have the following responsibilities:

- Conduct phone surveys and in-depth interviews
- Conduct on-site recruitment for metering sample

## **SDV / ACCI (DVBE)**

**Alex Norton** will have the following responsibilities:

- Manage all field work performed by SDV/ACCI
- Primary interface with ECONorthwest and SBW
- Assist with on-sites and field tasks

**Eskinder Behranu** will have the following responsibilities:

- Assist with on-sites and field work

## **TEAM MEMBER ASSIGNMENTS OF HOURS**

The discussion below presents our reasons for allocating the highest amount of hours to individual staff. We have limited this discussion to those that are expected to work 20 hours or more per month on average, as the RFP asks for this information only for those who are expected to commit the most work hours on the project. Additional detail on all employees and work hour expectations is available upon request.

## ECONORTHWEST

**Dr. Stephen Grover** will be the overall evaluation project manager and therefore will have a significant responsibility in terms of interacting with the Energy Division project manager as well as managing all of the subcontractors and major evaluation tasks. This involves leading the design of all major evaluation tasks and evaluation methods as well as managing their completion. He will also be responsible for coordinating the evaluation so it can be used in the Statewide study and the E3 calculator. Dr. Grover will also have primary responsibility for developing the individual EM&V plans for each of the Pilot programs. He will also be the lead author for the final report and conduct any evaluation presentations requested by the Energy Division. For these reasons, Dr. Grover is expected to have a significant amount of hours devoted to this evaluation.

**Alec Josephson** will be very involved with all data management, sample, and statistical analysis tasks. He was the lead analysis for all of ECONorthwest's work for the CPUC ORA in its review and verification of the pre-1998 evaluation work done by the IOU's. As a consequence, Mr. Josephson is very experienced in managing large datasets (including billing data, metered data, and survey data), developing samples, and running billing regression models. His experience will be invaluable in this evaluation for completing the data management and modeling tasks and assisting Dr. Grover with managing these tasks with the help of other junior staff.

**Jenny Yaillen** will handle much of the data management and statistical analysis prep work in terms of developing samples, managing survey and metered data, conducting billing regression models, and estimating net and gross impacts. In all cases, she will be working under the direct supervision of Dr. Grover. These tasks are similar to tasks she has already performed for several other evaluations, including the 2004-05 Express Efficiency impact evaluation discrete choice modeling and the billing regression and discrete choice modeling for the Energy Trust of Oregon's Home Energy Solutions program. Allocating more hours to Ms. Yaillen for these tasks (at her lower billing rate) allows more evaluation resources to be allocated to other tasks.

**Jessica Smith** will also be very involved in data management and statistical analysis prep work tasks in terms of developing samples, managing survey data, and estimating net and gross impacts. In all cases, she will be working under the direct supervision of Dr. Grover. These tasks are similar to tasks she has already performed successfully for several other evaluations, including the residential process evaluations for all of the 2006-08 residential programs for SDG&E and SCG and the current HEES evaluation for SCE. Having Ms. Smith work additional hours on these tasks under the supervision of Dr. Grover ensures that these tasks will be completed efficiently and allows for an optimal allocation of evaluation resources between senior and junior evaluation staff.

## SBW CONSULTING

**Ben Wildman** will be very involved in the technical aspects of the engineering analysis. As discussed above, Mr. Wildman's responsibilities will include:

- Develop site-specific M&V plans that detail the data collection and analysis for each measure at a sampled site.
- Conduct data collection (data loggers, EMCS trend logs, occupant and operator interviews), both pre and post, as needed to complete the impact evaluations for projects involving either complex measures or complex facilities.
- Conduct water and energy savings analysis for projects involving either complex measures or complex facilities.

- Assist in the development and calibration of embedded energy estimation models, especially as they pertain to energy used water or waste water treatment facilities.

To take advantage of Mr. Wildman's extensive experience in these areas and given the complexity of the analysis involved, Mr. Wildman has been assigned additional hours in this evaluation.

**Bing Tso** is also expected to be extensively involved with the engineering and metered data collection tasks of this evaluation. As discussed above, tasks for Mr. Tso include:

- Develop site-specific M&V plans that detail the data collection and analysis for each measure at a sampled site.
- Conduct data collection (data loggers, EMCS trend logs, occupant and operator interviews), both pre and post, as needed to complete the impact evaluations for projects involving either complex measures or complex facilities.
- Conduct water and energy savings analysis for projects involving either complex measures or complex facilities.
- Assist in the development and calibration of embedded energy estimation models, especially as they pertain to energy used water or waste water treatment facilities.

Given these tasks and the complexity of the analysis involved (and Mr. Tso's experience in these areas), Mr. Tso has been assigned additional hours in this evaluation.

**Shefali Modi** will be involved in the following labor-intensive tasks with Mr. Wildman and Mr. Tso:

- Develop site-specific M&V plans that detail the data collection and analysis for each measure at a sampled site.
- Conduct data collection (data loggers, EMCS trend logs, occupant and operator interviews), both pre and post, as needed to complete the impact evaluations for projects involving either complex measures or complex facilities.
- Conduct water and energy savings analysis for projects involving either complex measures or complex facilities.
- Assist in the development and calibration of embedded energy estimation models, especially as they pertain to energy used water or waste water treatment facilities.

Given the nature of these tasks and their complexity, Ms. Modi has been allocated additional hours in this evaluation.

**Randy Birk** is expected to be very involved in the engineering analysis and on-site metering for this evaluation, which include the actual installation of some of the meters. Specific tasks include:

- Specification and preparation of appropriate metering equipment. Assist with the development of the EM&V plan for each of the programs in this group.
- Install metering equipment
- Conduct data collection (data loggers, EMCS trend logs, occupant and operator interviews), both pre and post, as needed to complete the impact evaluations for projects involving either complex measures or complex facilities.

- Conduct water and energy savings analysis for projects involving either complex measures or complex facilities.

Consequently, given that these tasks are complex and time-intensive, Mr. Birk has been assigned additional hours in this evaluation.

## **POPULATION RESEARCH SYSTEMS**

*Candace Farley* will be one of the primary interviewers responsible for completing the phone surveys, recruiting interviews, and any in-depth interviews proposed for this evaluation. Given the number of surveys that are expected for this evaluation, this requires additional hours to be allocated to Ms. Farley

*David Cybulski* will be one of the primary interviewers responsible for completing the phone surveys, recruiting interviews, and any in-depth interviews proposed for this evaluation. Given the number of surveys that are expected for this evaluation, this requires additional hours to be allocated to Mr. Cybulski.

## **ADMINISTRATIVE AND TECHNICAL STAFF SUPPORT**

For the ECONorthwest team, the administrative staff will assist with basic paperwork and administrative duties that are required for any project. Specifically, our administrative staff will handle tasks relating to contracting, invoicing, faxing, copying, and report printing. Our administrative staff has done similar work for literally hundreds of projects and we have developed internal procedures to complete these tasks as efficiently as possible. ECONorthwest is currently a subcontractor on two of the other CPUC impact evaluation groups (Small Commercial and Local Government Partnerships) and therefore is familiar with the invoicing, expense reporting, and documentation procedures established for evaluation work with the CPUC.

The vast majority of technical work described in our proposal will be completed by staff already discussed above. In some cases, however, it may be possible to complete some of the tasks with junior staff (with lower billing rates) that are nonetheless qualified for the job. For example, some of the phone surveys could be automated into a CATI system, or on-site verification visits can be completed by junior field staff at a lower hourly rate. If these opportunities occur, we will discuss with the CPUC the potential benefits of using these additional technical staff for survey and on-site work. We will submit documentation to the CPUC for each proposed staff member to establish his/her qualifications.



# Section 3: Expanded Resumes / Professional Work Experience and Qualifications

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**STEPHEN GROVER**

**Principal, ECONorthwest**

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## **EDUCATION**

- Ph.D., Economics, University of Wisconsin-Madison (1996)
- M.S., Economics, University of Wisconsin-Madison (1993)
- B.A., Economics, Pacific Lutheran University, Tacoma, WA (1989)

## **EMPLOYMENT HISTORY (14 YEARS PROFESSIONAL EXPERIENCE)**

- Principal, ECONorthwest, 2000-Present
- Quantum Consulting, 1996-2000
- Battelle Pacific Northwest Laboratory, 1989-1991

## **SELECTED PROJECT EXPERIENCE**

Dr. Grover was the project manager and designed the evaluation analysis tasks for the following projects:

**Impact Evaluation of a Commercial Gas DSM Program.** For Southern California Gas (SCG), ECONorthwest conducted the 2004-05 impact evaluation of the Nonresidential Financial Incentives Program that targets small and medium gas customers. Through the program, financial incentives are provided to replace existing gas equipment or to improve industrial processes to reduce gas consumption. Evaluation tasks included a billing regression model to estimate net realized impacts, customer phone surveys in support of a process evaluation of program delivery, on-site audits to verify equipment installation, and a self-report free ridership analysis. The evaluation also included a detailed review of the data tracking procedures and the savings calculations used to develop the initial savings estimates by SCG. In addition to presenting net realized impacts, the final evaluation report presented recommendations for program improvements and procedures that needed to be adopted by SCG to improve the evaluability of the program.

**Audit of Enbridge's 2002, 2003, and 2004 DSM Evaluation Reports.** For Enbridge Gas Distribution, ECONorthwest conducted an audit of the 2002, 2003, and 2004 evaluation reports. These audits included reviewing the savings calculations for a representative sample of projects for each of the major DSM programs. Measures covered in these programs include low-flow showerheads, faucet aerators, water heaters, boilers, steam traps, furnaces, and industrial process improvements. The final report provided recommendations on how some of the savings calculations should be revised. The report also reviewed the cost effectiveness calculations and provided guidance for values on some of the underlying analysis parameters such as free ridership rates and the proper treatment of taxes in the cost effectiveness calculations.

**Statewide Emerging Technologies Program Evaluation.** ECONorthwest evaluated the 2004-05 Statewide Emerging Technologies Program. Evaluation activities included developing a logic model and

program theory for the program, conducting in-depth interviews, and conducting evaluation case studies on selected technology assessments. These case studies were used to demonstrate the program theory by identifying the various metrics of program progress that were developed as part of the logic model. The evaluation was designed to be a test run of the 2006-08 Evaluation Protocols, and the final report included recommendations on data tracking, program improvements, and research issues that should be addressed in future evaluations.

**Impact Evaluation and Discrete Choice Modeling for Small Commercial Energy Conservation Programs.** For the CPUC, ECONorthwest (as a sub to Itron) is assisting with the impact evaluation of multiple energy conservation programs that target the small commercial customer market sector. Tasks include assisting with developing the evaluation plan, developing sample methods, and creating models to estimate net realized energy impacts resulting from the programs. Modeling techniques include billing regression analysis and discrete choice models of customer equipment choices. ECONorthwest also managed (for Itron) the discrete choice modeling and logic model tasks for the Express Efficiency and the Nonresidential Audit program as part of the 2004-05 impact evaluation.

**Verification Audit of DSM Evaluations for the State of California.** From 1995 to 2003, ECONorthwest was retained by the CPUC Office of Ratepayer Advocates to verify all of the analysis used to evaluate DSM programs for the California IOU's. Dr. Grover helped manage this program beginning in 2001. Each year this involved reviewing 20 to 30 separate energy conservation program impact evaluations. ECONorthwest's work on this project has had enormous implications for California utilities, policy makers, and ratepayers and the results of our analysis can impact utility earnings claims by tens of millions of dollars. For example, in 1999 the utilities claimed a total of over 100 million dollars in lost earnings due to the DSM programs. Based on ECONorthwest's review of the analysis supporting this claim, this number was adjusted downward by over 30 million dollars. In addition, our recommendations influenced the procedures set by California for estimating the energy savings associated with all IOU DSM programs.

## RELEVANT EXPERTISE AND QUALIFICATIONS

### *Understanding of program evaluation theory*

Dr. Grover has been involved in numerous process and impact evaluations designed to estimate *ex post* net program impacts and generally improve program delivery and evaluability. These evaluations have involved estimating net effects using net billing models (including specifications utilizing the Double Inverse Mills Ratio) and discrete choice models of equipment choice. Current work on the discrete choice analysis includes a nested logit model that will link the effects of the 2004-05 Statewide Nonresidential Audit program and the Statewide Express Efficiency program for commercial customers. Dr. Grover has also developed phone surveys for multiple evaluations with batteries of questions specifically designed to develop self-report estimates of free ridership, participant spillover, and nonparticipant spillover effects. Whenever possible, several different methods are used to help corroborate the results across techniques. Finally, Dr. Grover has also developed numerous logic models for the California IOUs, NYSERDA, Energy Trust of Oregon, Northwest Energy Efficiency Alliance, BPA, and the Oregon Department of Energy. These logic models were used to identify important research issues and develop specific metrics of program progress to address these research areas.

In addition to his role as an evaluator, Dr. Grover was also involved in these studies when he managed the verification work performed for the CPUC Office of Ratepayer Advocates on the impact evaluations submitted for the annual AEAP. As part of the verification, Dr. Grover and other ECONorthwest staff reviewed all of the statistical models used to estimate net impacts for the pre-1998 efficiency programs. This involved re-estimating each billing model and then developing alternative model specifications to determine how sensitive the reported impacts were to the particular model specification reported by the evaluation.



### ***Experience evaluating programs in California***

Dr. Grover has managed multiple impact and process evaluations for each of the California IOU's covering both residential and commercial sector programs. Currently Dr. Grover is a subcontractor on the Small Commercial and Local Government Partnership impact evaluations for the CPUC. Additional evaluations for the 2004-05 program cycle include impact evaluations for 6 PG&E Local Government Partnership programs, the SDG&E Small Business Energy Efficiency program, SCE's Nonresidential Hard-to-Reach program, SCG's Nonresidential Financial Incentives program, and the Statewide Emerging Technologies Program. As discussed above, Dr. Grover was also extensively involved with the verification review of the pre-1998 DSM program evaluations for the ORA.

### ***Statistical analysis, specifically regression modeling and sampling***

Dr. Grover has employed a broad range of different statistical models in multiple impact evaluations. Models have ranged from the billing regression models comparing pre- and post-installation on both a monthly and annual level. In addition, Dr. Grover has used the Double Inverse Mills ratio to correct for potential self-selection bias in evaluations of PG&E's Commercial Lighting and HVAC programs. He has also developed multi-stage discrete models to estimate customer equipment choices using both revealed and stated preference data for residential and commercial efficiency programs. In particular, Dr. Grover has designed and implemented several conjoint studies using an orthogonal choice design to estimate consumer preferences for energy efficient equipment options and participation in utility load control programs. He is currently working on developing a nested logit model that will link customer equipment choice with decisions to participate in both the Statewide Non-residential Audit and Express Efficiency Programs. Work on this model will continue as part of the 2006-08 impact evaluations within the Small Commercial Contract Group. Software that was used to estimate these models include SAS, Eviews, and LimDep.

Dr. Grover has designed sampling schemes in support of multiple impact evaluation tasks, including survey samples, billing regressions, discrete choice modeling, and on-site verification audits. For on-site verification audits, a cluster sampling technique was used where the sample was stratified to maximize the total savings in the sample while minimizing travel times between sites. This allowed for the maximum number of sites and total savings to be covered during the fixed sampling period. For an evaluation of the ENERGY STAR Homes Northwest program for NEEA, two different sample weighting schemes were developed for builders (based on construction volume and builder population) to ameliorate any potential bias among sample strata. Dr. Grover is also managing all of the sampling tasks involved for surveys, metering, and on-site verifications as part of the 2006-08 impact evaluation for the Local Government Partnership programs as a subcontractor to Summit Blue.

### ***Development of survey instruments and interviewing***

Dr. Grover has developed survey instruments for virtually all of the evaluation projects he has managed. This includes extensive and sophisticated phone surveys, on-line surveys, and in-depth interviews. He has conducted in-depth interviews and moderated focus groups as part of his evaluation and energy projects. Dr. Grover has also designed and implemented conjoint analysis surveys, in which respondents are recruited for an on-site data collection session where they are asked to rank various equipment choice offerings. The ranking data were then used to develop models that helped estimate consumer preferences for energy efficiency and ultimately estimate market penetration for various energy efficiency program offerings for Florida Power and Light.

### ***Coordination and management of evaluation work***

Dr. Grover regularly manages large-scale impact and process evaluations that involve coordination across stakeholders and multiple subcontractors. A recent example of this is the 2006-08 process evaluations for all of SDG&E and SCG residential programs. This involved managing 6 subcontractors, interacting with

multiple project managers at both utilities, and developing separate evaluation plans for 20 different programs. Dr. Grover also worked with a team of evaluators (as a sub to Kema) to conduct the 2006-08 process evaluations for all of SDG&E's and SCG's nonresidential programs. Dr. Grover is currently working with multiple team members, the Energy Division, and the MECT as manager of the survey data collection and verification for all CFL giveaway events conducted as part of the 2006-08 programs. In addition to managing large impact evaluations for each of the IOU's, Dr. Grover has also managed evaluation projects for NYSERDA, Energy Trust of Oregon, Florida Power and Light, the Northwest Energy Efficiency Alliance, Union Gas, Enbridge Gas Distribution, and the Bonneville Power Administration.

***Experience working with implementers to ensure program evaluability***

Most of the evaluation projects Dr. Grover has worked on have provided specific recommendations on issues relating to evaluability. This includes developing detailed recommendations on program documentation and data tracking that will allow for proper program evaluation in future years. Specific examples of this include the audits over multiple years for Enbridge Gas Distribution that provided detailed recommendations on evaluation methods, documentation, and project tracking. Dr. Grover also directed ECONorthwest's work on developing logic models for NYSERDA, with each logic model containing specific metrics to measure important links between program activities and expected outcomes.

## MARK BUCKLEY

### Senior Economist, ECONorthwest

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#### EDUCATION

- Ph.D., Environmental Studies, University of California-Santa Cruz (2007)
- B.A., Economics, Davidson College, Davidson, NC (1998)

#### EMPLOYMENT HISTORY (11 YEARS PROFESSIONAL EXPERIENCE)

- Senior Economist, ECONorthwest, 2008-Present
- Environmental Economist, Environmental Incentives, 2006-2008
- Visiting Researcher, Department of Forestry-University of Montana, 2005-2006
- Economic Consultant, Independent 2000-2006
- Instructor, Research Assistant, Teaching Assistant, University of California, 2001-2005
- Associate Economist, Research Triangle Institute, 1998-2000

#### SELECTED PROJECT EXPERIENCE

**Feasibility Assessment and Design of a Water Quality Crediting and Trading System, California and Nevada (2006-present).** Dr. Buckley is currently playing a lead role in the feasibility assessment and design of a water quality crediting and trading system for Lake Tahoe in California and Nevada. The project team is identifying and developing mechanisms to increase the efficiency of efforts and expenditures to improve water quality in Lake Tahoe. Recognizing high variability in marginal costs of pollutant control and insufficient funds to conduct all available BMPs, the project team is developing a crediting system in order to identify and compare the value of pollutant control opportunities. The crediting system will be able to handle efficiency gains from offsite mitigation at multiple scales. The program design considers the complex political network (two states), high environmental quality of the water resource, existing resource uses, and funding patterns to tailor the project to regional constraints and opportunities. The project is funded by the U.S. EPA and overseen by the Lahontan Regional Water Quality Control Board.

#### **Developing a Tool to Guide State and Local Desalination Planning, California (2006).**

As part of a large team, Dr. Buckley worked on a spreadsheet tool for use by local water agencies in California to assess and compare costs and benefits of incorporating desalination into their water supply portfolio. The tool includes consideration of water reuse and desalination options for water supply increases and reserves. In addition to financial considerations, non-market values are incorporated, including environmental, recreational, human health, and cultural costs and benefits. Dr. Buckley developed new tool components that help communities consider the distributional equity tradeoffs between various new water supply opportunities in comparison to and conjunction with existing supplies. The project team included researchers from the University of California, local water agencies and stakeholder organizations, with funding from Proposition 50 administered by the California Department of Water Resources (overall project budget of \$2.6 million).

Economic Analysis of Environmental Impacts of Cooling Operations for Coastal Power Plants and Proposed Mitigation, California (2003-2005). In support of multiple California coastal communities and in tandem with Earthjustice Legal Defense Fund, Dr. Buckley conducted economic analyses to assess the costs and benefits of various technological and ecological approaches to mitigating estuarine and marine impacts of power plant cooling operations. The analyses used habitat equivalency analysis as well as considering risk and uncertainty differentials between the various cooling and associated mitigation options for power plants in Monterey Bay and Morro Bay.

**Sacramento River Restoration Decision-Making Simulations, California (2003-2006).** With funding from the National Science Foundation and the USDA, Dr. Buckley designed and conducted game-theoretic and agent-based simulation models to identify successful strategies for river restoration efforts among existing agricultural land uses on the Sacramento River. Dr. Buckley conducted a survey of local farmers and combined the results with market and biological data to inform simulations that identified behavioral patterns and associated policy prescriptions. In particular, the simulations demonstrated the importance to all interests of moderating on-site goals to control off-site externalities, and the impact of risk aversion among farmers on river restoration goals.

**Watershed Resources Management Plan, Santa Cruz, California (2001).** Mark Buckley worked with hydrologists and ecologists to identify the costs and benefits of various watershed management options for the Santa Cruz Water Department. The city owns much of the watershed for its water supply, and compared various land use options, including selective logging, to achieve community goals for water quality, water quantity, and environmental benefits.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Experience evaluating programs in California***

Dr. Buckley has contributed to design and evaluation of several water-related programs throughout California. Currently, Dr. Buckley is participating in the design of a program to facilitate achievement of TMDL water quality goals for Lake Tahoe across multiple jurisdictions and involving public and private entities, including businesses and homeowners. Related to this effort is Dr. Buckley's involvement in the design and implementation of an adaptive management system for the implementation, monitoring, and updating of the Lake Tahoe program for coordinating resource management throughout the basin. Key to this program has been the design of explicit program evaluation via targeted monitoring and verification at scale-dependent time intervals.

Dr. Buckley evaluated failures in the program to restore the Sacramento River Conservation Area in northern California via surveys, modeling, and simulations. These analyses generated recommendations for improvements in the system of farmer-interaction. Results of the work have been published in the journals *Environmental Management* and *Conservation Biology*, and the book *Restoring Natural Capital* (simulation results in review).

### ***Statistical analysis, specifically regression modeling and sampling***

Dr. Buckley has conducted a variety of statistical analyses and empirical modeling in order to assess programs and policies for natural resource management. For example, Dr. Buckley conducted regression analyses to identify the marginal cost impact of the Clean Water Act net of a counterfactual state consisting of only state and local water quality regulations for the U.S. EPA Office of Water. Dr. Buckley designed a program using Monte Carlo sampling to simulate decision-making interactions between river restoration planners and farmers for the Sacramento River. Simulations and sampling designs for landscape-scale restoration improvement by Dr. Buckley include game-theoretic and agent-based techniques.

Dr. Buckley created and instructed a course for senior majors on computer modeling techniques for water policy at the University of California, Santa Cruz. For the course, Dr. Buckley guided development and use of spreadsheet, database, statistical and Visual Basic-based analyses for topics such as dam management, groundwater management, and water supply adaptations for climate change.

### ***Development of survey instruments and interviewing***

Dr. Buckley designed and administered a survey of farmers to assess decision-making contingent on a variety of river and riparian corridor management scenarios on the Sacramento River. Interviews and

focus group meetings prior and subsequent to implementing the survey instrument aided the design and results assessment. Mark Buckley aided in the design and provided the analysis and database construction for monitoring costs associated with coordinating Lake Tahoe resource management under an adaptive management system. The database and analyses required extensive follow-up interviews with resource managers from government agencies to conduct cost analyses. The desalination assessment tool for local California water agencies and stakeholder groups in part designed by Dr. Buckley provides a survey and focus group tool to facilitate decision-making on water supply options.

***Experience working with local water agencies, especially evaluating water conservation programs***

Mark Buckley has worked extensively with water agencies and regional water quality control boards in California. His work with the Santa Cruz Water Department combined water and land conservation efforts for watershed management option assessment. The desalination tool project for the California Department of Water Resources is targeted to meet the needs of local water agencies and has been developed in conjunction with the Long Beach Water Department and the Inland Empire Utilities Agency. He has worked with both the Central Coast and Lahontan Regional Water Quality Control Boards for landowner decision-making analysis.

***Experience with water systems analysis including physical and engineering principles***

The desalination planning tool for California water agencies provides assessment of physical and engineering opportunities and constraints for water supply options. Cost assessments for Lake Tahoe resource management and water quality crediting and trading design reflect physical and engineering constraints to water resources as well.

***Overall experience in the water field in California***

Since 2000, Dr. Buckley's studies, research, and consulting have focused on problems of managing water resources in California. The complexity of supply systems and demand uses coupled with a progressive populace makes for relevance beyond state borders. Dr. Buckley's doctoral coursework combined microeconomics and econometrics with applied math, political science, hydrology, groundwater and biology. His water research involvement has spanned local water supply and consumption, state-level adaptability to climate change, river restoration and monitoring, water impacts of power plant cooling operations, and water quality markets. He has worked directly with agency staff and executives, homeowners and businesses, farmers and non-profits, and academic and government scientists. Dr. Buckley is currently a research fellow with the Center for Integrated Water Research of the University of California.

## CHRISTIAN MINER

### Economist, ECONorthwest

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#### EDUCATION

- M.S., Economics, Portland State University (2006)
- B.S., Systems Engineering, United States Military Academy, West Point, NY (1994)

#### EMPLOYMENT HISTORY (14 YEARS PROFESSIONAL EXPERIENCE)

- Economist, ECONorthwest, 2007-Present
- Northwest Energy Efficiency Alliance, 2007
- Portland Public Schools, 2003-2004
- Oregon State Legislature, 2002-2003
- Boosey and Hawkes, 2001-2002
- Halo, Inc., 1999-2001
- United States Army, 1994-1999

#### SELECTED PROJECT EXPERIENCE

**2006-08 CPUC Government Partnerships Impacts Evaluation.** Christian is a member of the consulting team that is evaluating over 50 programs offered by several investor owned utilities in California and their state, local government, or community organization partners. These programs seek to modify customer behaviors either directly (through activities such as CFL distributions, energy efficiency measure incentives, direct installs), indirectly (through training and educational events), or by encouraging them to participate in core utility programs. For this evaluation Christian is the primary investigator for five partnership programs and will be responsible for documenting both the direct and indirect impacts due to marketing, outreach and training.

**2003-05 CEC State Pricing Pilot Evaluation.** In order to more fully understand the risks involved with time-of-use pricing methods, Christian developed a model for simulating the realization of risk transfers as a result of peak-pricing models. The analysis consisted of 2500 volunteer households located in the service territories of SDG&E, SCE, and PG&E. Eighteen months of consumption data, during both peak and off-peak hours, were studied to determine the amount of energy consumption transferred to and from peak hours under several different time-of-use pricing regimes.

**2006-08 Process Evaluation of the SDG&E and SCG Non-residential Energy Efficiency Programs.** For SDG&E and SCG, assisted with the process evaluation for programs targeting small and medium commercial and industrial customers. In each of the programs, financial incentives are provided to customers for purchasing energy efficient equipment. Evaluation tasks include customer phone surveys in support of a process evaluation of program delivery and in-depth interviews with equipment vendors and installation contractors.

**Evaluation of the California Statewide Technical Assistance and Technology Incentive Program.** As part of the overall process evaluation, Christian is managing the development of a discrete choice logit model that estimates the probability customers will install demand response equipment (and join a demand response program) based on the characteristics of the company and each firm's equipment recommendations. Additionally, Christian is managing both the in-depth interviews and phone surveys conducted with program participants as part of the evaluation.



## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Understanding of program evaluation theory***

Christian has developed program theory and logic models for several clients including SCG, SCE, SDG&E and PG&E. Based on the logic models and program theory, key research issues were identified to shape all of the remaining evaluation data collection and analysis activities (e.g., market actor interviews, participant survey design, on-site audits, program data analysis). Additionally, Christian has implemented California's Best Practices theory into the 2006-08 process evaluation of the SDG&E and SCG non-residential programs.

### ***Experience evaluating programs in California***

Christian has worked on multiple energy evaluation projects in California and is currently working on the Small Commercial and Local Government Partnership impact evaluations for the CPUC. Additionally, Christian has been extensively involved with the 2006-08 process evaluation of all the SDG&E and SCG residential and non-residential programs and has helped managed the evaluation of the Statewide Technical Assistance and Technology Incentives program. He is also working on ECONorthwest's current evaluations of the Home Energy Efficiency Survey for both SCE and PG&E. Additional California energy projects include subjects such as time-of-use pricing, risk analysis, forecasting, program delivery and wastewater energy efficiency.

### ***Energy modeling, specifically energy engineering principles and simple engineering models***

As an energy analyst for the Northwest Energy Efficiency Alliance, Christian designed several cost-effectiveness models to account for and forecast energy savings using engineering estimates for magnetic transmissions, variable frequency evaporative fans, and wastewater management systems. Christian has designed and built numerous statistically adjusted engineering billing models to estimate energy savings conditional upon operating hours, weather, and building characteristics, the latest being a model of energy savings for the Industrial Efficiency Alliance.

### ***Statistical analysis, specifically regression modeling and sampling***

Christian has designed several sampling plans for utilities in California involving survey and interview samples of customers for SDG&E, SCE, SCG, and PG&E customers. Christian has also conducted a variety of regression models for these California utilities. The latest is a logit model designed to estimate the probability of program enrollment given specific firm characteristics, which is being done as part of the evaluation of the Statewide Technical Assistance and Technology Incentives program. He will also be working on the discrete choice analysis planned for the CPUC's Small Commercial program impact evaluations.

### ***Experience with the energy management and control systems of water agencies, specifically calculating energy use of pumps or treatment facilities***

Christian has recently participated in an energy audit of the Alvarado Water Treatment facility in San Diego, California. Here he saw first hand the requirements for upgrading the SCADA system and estimating the curtailment and total energy usage for pumps at the facility. This visit was part of a demand response program aimed at curtailing 8 MW of energy from the Alvarado facility.

### ***Experience with pre- and post-measurement and analysis, specifically collecting pre-data***

While working for the Industrial Efficiency Alliance, Christian has been instrumental in helping estimate changes in energy efficiency at numerous industrial locations. This has all been done through the use of both pre- and post-billing data to determine the changes in energy intensity on an annual basis. As a result

of Christian's work, the Industrial Efficiency Alliance will be able to claim energy savings for the first time since the organization's inception 5 years ago.



# JOHN BOROSKI

## Senior Economist, ECONorthwest

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### EDUCATION

- Master of Urban and Regional Planning, Portland State University (1998)
- B.A. Economics, University of Notre Dame (1988)

### EMPLOYMENT HISTORY (20 YEARS PROFESSIONAL EXPERIENCE)

- Sr. Economist, ECONorthwest, 2006–Present
- Parsons Brinckerhoff, 1999-2006
- Tri-County Metropolitan Transportation District of Oregon (TriMet), 1997-1999
- Portland Development Commission, 1996-1997
- Oregon Health Sciences University, 1994-1995
- Hewitt Associates, 1988-1993

### SELECTED PROJECT EXPERIENCE

**2006-08 CPUC Government Partnerships Impacts Evaluation.** John is on the consultant team that is evaluating over 50 programs being offered by the investor owned utilities in California and their state, local government, or community organization partners. These programs seek to cause customers to modify their behaviors either directly (through activities such as CFL distributions, energy efficiency measure incentives, direct installs), indirectly (through training and educational events), or by encouraging them to participate in core utility programs. For this evaluation John is the primary investigator for multiple partnership programs and will be responsible for documenting direct impacts (for programs with resource acquisition goals) and indirect impacts due to marketing, outreach and training.

**2006-08 Residential Programs Process Evaluations.** For SDG&E and SCG, John helped to conduct a process evaluation of all the 2006-08 residential efficiency programs. This evaluation included the development of program theory and logic models for all programs, in-depth interviews with program managers and implementers, development of customer participant surveys, analysis of the survey results, comparison of program design and delivery with established best practices, and recommendations to improve program effectiveness.

**2004-05 Non-residential Hard-to-Reach Program Impact Evaluation.** For SCE, John helped to conduct an evaluation of the *Ex-Post* net program impacts of a program targeting Hard-to-Reach small and medium non-residential customers. This evaluation included customer phone surveys in support of a process evaluation of program delivery, and a self-report analysis of free ridership, on-site verification audits, and a net billing model. These methods were used to corroborate results across the different techniques, and the results were combined to estimate net realized impacts.

**2004-05 PG&E Government Partnerships Process and Impacts Evaluation.** John was extensively involved in the data analysis for the 2004-05 impact and process evaluation for 6 of PG&E's Local Government Programs (East Bay, Silicon Valley, El Dorado, Bakersfield-Kern County, Fresno, and Stockton). The evaluation included program participant and non-participant surveys, and a portfolio analysis in which Partnership performance was measured collectively as a group and relative to each other and initial program goals. The evaluation included a self-report analysis of free ridership, on-site verification audits, and a review of the savings calculations to estimate program impacts. These results were combined to estimate net realized impacts for each Partnership.

**California Statewide 2004-05 Emerging Technology Evaluation.** This program conducts technology assessments and provides information on emerging technologies that are ready to be promoted through

other energy efficiency programs. Evaluation activities include developing a logic model and program theory for the program, conducting in-depth interviews, and conducting evaluation case studies on selected technology assessments. Recommendations were also made for future evaluation activities.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Understanding of program evaluation theory***

John has developed program theory and logic models for several clients including NYSERDA (low-income and R&D), SCG and SDG&E (residential and non-residential), the Northwest Energy Efficiency Alliance (ENERGY STAR Homes) and the Oregon Department of Energy (tax credit programs). Based on the logic models and program theory, key research issues were identified to shape all of the remaining evaluation data collection and analysis activities (e.g., market actor interviews, participant survey design, on-site audits, program data analysis).

### ***Experience evaluating programs in California***

In addition to projects highlighted in the Selected Project Experience section, John has also contributed to process evaluations of SCG and SDG&E's nonresidential programs (program theory, logic models, in-depth interviews) and also an evaluation of KEMA's California Energy Efficiency Loan Program, for which John documented lender experience with and perceptions of energy efficiency loan buy-down programs.

### ***Development of survey instruments and interviewing***

John has developed phone survey instruments for program participants and non-participants for the Oregon Department of Energy, SCG, SDG&E and Northwest Energy Efficiency Alliance. He has also designed in-depth interview guides and conducted numerous in-depth interviews with energy program stakeholders in the residential, commercial, industrial and R&D sectors.

### ***Coordination and management of evaluation work***

John has managed and reviewed the work of project team members, sub-consultants and internal staff for several projects. Tasks for which John has coordinated and managed evaluation activities include data collection and analysis, large-scale survey fielding and administration, in-depth interviews, field audits, and on-site program event attendance.

## ALEC JOSEPHSON

### Economist, ECONorthwest

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#### EDUCATION

- M.S. Economics, Portland State University
- B.S. Political Science, Portland State University

#### EMPLOYMENT HISTORY (17 YEARS PROFESSIONAL EXPERIENCE)

- Economist, ECONorthwest, 1991-Present
- Adjunct Professor of Economics, Pacific University, 2004-Present, Courses in energy and environmental economics, applied microeconomics, and macroeconomics
- Economics Instructor, various local colleges, 1991-2004, Courses in microeconomics, macroeconomics, international economics, economic history, and industrial organization
- Program Coordinator, Oregon Council on Economic Education, 2002-2007

#### SELECTED PROJECT EXPERIENCE

**Energy Efficiency Evaluation Review and Verification for the CPUC.** For six years, Josephson was ECONorthwest's lead analyst in the annual evaluation of four California utilities' reporting of forecasted and actual costs, benefits, and earnings for DSM programs. His work included data and engineering reviews of sampled program participants, verification of load impact and measure retention studies, review of administrative cost allocations and procedures, verification of parameters and calculations in summary earnings tables, and presentation of findings and recommendations at DSM workshops and in annual staff reports for the Office of Ratepayer Advocates.

**Economic and Fiscal Impact Analysis of Energy Efficiency Programs.** For the Energy Trust of Oregon, Josephson led the input-output modeling effort to estimate the economic and fiscal impacts associated with their commercial, industrial, and residential energy efficiency and renewables programs. This project involved the detailed review of program activities, including net energy savings and incremental measure costs, by program and by customer. ECONorthwest was able to feed this data into a specially constructed input-output model of the Oregon economy, and evaluate the gross and net impacts associated with ETO's programs.

**Audit of Enbridge Consumers Gas DSM Energy Conservation Program.** For a gas utility in Ontario, Canada, ECONorthwest conducted a verification and review of their DSM energy conservation program evaluation. Audit tasks included reviewing all of the savings calculated with its gas conservation programs and providing recommendations for future evaluations.

**NEEA Hospital Energy Finance Resource Guide.** For the Northwest Energy Efficiency Alliance, ECONorthwest developed a financial resource guide for hospitals considering investments in energy efficient equipment. This resource guide describes different types of financing options and incentives available from state agencies and utilities within the program territory. A spreadsheet tool was provided along with a written report that allows different financing options to be compared.

**Economic and Fiscal Impact Analysis of Oregon's Energy Tax Credit Programs.** For the Oregon Department of Energy, ECONorthwest evaluated the economic and fiscal impacts associated with their Business Energy Tax Credit (BETC) and Residential Energy Tax Credit (RETC) programs. This involved a detailed review, by individual participant, of the energy efficiency measures installed, the incremental costs (both equipment and labor), the net energy savings and the foregone revenues for electric and gas utilities.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Understanding of program evaluation theory***

Josephson's program evaluation background includes six years working as ECONorthwest's lead analyst in the review of California utilities' DSM programs. This included verification work related to utilities' first year earnings claims, and review and replication of utilities' load impact studies and measure retention studies submitted to support their second and third earnings claims, respectively. Josephson also provided analysis for two annual audits of a Canadian gas utility's DSM energy conservation program evaluation.

### ***Experience evaluating programs in California***

For the CPUC, Josephson was ECONorthwest's lead analyst in the evaluation and verification of four California utilities' reporting of forecasted and actual costs, benefits, and earnings for Demand-side Management Programs. His work spanned six years, and included working closely with utility and CPUC staff to develop summary earnings tables ("E-Tables") in which program costs, benefits, and earnings are reported and revised.

### ***Statistical analysis, specifically regression modeling and sampling***

As part of the CPUC review of utilities' Demand-side Management Programs, Josephson assisted in the review of utilities' load impact studies submitted to support their second year earnings claims. This review process was accomplished and reported on two levels. First, a Review Memo represents a paper review of the particular load impact study submitted by the utility. Second, a Verification Report represents an extensive review and replication of the sampling, billing data, and modeling procedures used in the utility study, or a detailed replication of engineering-based, project-specific calculations used in the study. Over his six-year involvement in CPUC verification work, Josephson led or assisted on the review of well over fifty load impact studies.

In addition, Josephson led or assisted on ECONorthwest's verification efforts related to utilities' measure retention studies filed to support the Effective Useful Life (EUL) estimates used to calculate third year earnings.

### ***Coordination and management of evaluation work***

As ECONorthwest's lead analyst in the CPUC's review of utilities' DSM Programs, Josephson coordinated the review efforts between ECONorthwest and our sub-consultants, and utility staff and their consultants. For most program years, this involved coordinating and communicating with staff from numerous entities. Importantly, Josephson worked with all parties involved to make the final adjustments to the utilities' earnings claims, as reported in the summary earnings tables, and co-authored CPUC's *Staff Reports* presenting the review, findings, and recommendations for each Annual Earnings Assessment Proceedings (AEAPs).

Josephson also took part in the audits of a Canadian gas utility's conservation program. This involved managing ECONorthwest's detailed file-level review, and coordinating with utility staff to obtain program data and provide suggestions to improve their program performance evaluation processes.

## JENNY YAILLEN

### Research Assistant, ECONorthwest

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#### EDUCATION

- B.S., Economics, University of Oregon (2007)
- B.S., Mathematics, University of Oregon (2007)

#### EMPLOYMENT HISTORY (1 YEAR PROFESSIONAL EXPERIENCE)

- Research Assistant, ECONorthwest, 2007-Present

#### SELECTED PROJECT EXPERIENCE

**Statewide 2004-05 Express Efficiency Impact Evaluation.** As part of the subcontracted team to Itron, Ms. Yaillen is assisting with the net impact analysis that involves developing a discrete choice nested logit model which links participation in the Non-residential Audit program with participation in the Express Efficiency program. This analysis will help identify the contribution that the Non-residential Audit program is making to overall Express participation. Ms. Yaillen is currently conducting the discrete choice modeling for lighting (T8/T5s and CFLs) and for HVAC measures. She will also be assisting in the application of these models for the 2006-08 programs as part of the Small Commercial Contract Group.

**2004-06 Home Energy Solutions Process and Impact Evaluation.** For Energy Trust of Oregon, Ms. Yaillen is conducting a billing regression analysis that will be used to determine net impacts of this residential rebate program. The program, which serves customers of the major gas and electric utilities in the state of Oregon, provides financial incentives for the replacement or retrofitting of existing gas and electric equipment. Other evaluation tasks Ms. Yaillen is involved in include developing survey instruments, analyzing survey data, and documenting program history.

**Statewide 2006-08 Emerging Technology Process Evaluation.** Ms. Yaillen is assisting with evaluation activities for the most recent round of evaluation for the Emerging Technology Program. This program conducts technology assessments and provides information on emerging technologies that are ready to be promoted through other energy efficiency programs. She is involved in developing a logic model and program theory for the evaluation.

**SDG&E/SCG 2006-08 Residential Programs Evaluation.** For the SDG&E and SCG 2006-08 Residential Program Process Evaluation, Ms. Yaillen developed logic models for many of the residential programs that were included as a part of this evaluation. She also compiled information on program history and documented program theory for each program. Part of Ms. Yaillen's responsibility for this evaluation also included collecting and organizing participant survey samples and developing selected survey questions.

#### RELEVANT EXPERTISE AND QUALIFICATIONS

##### *Understanding of program evaluation theory*

Ms. Yaillen has worked on multiple program evaluations for energy-related programs and has developed several logic models in support of these evaluations. She has experience with both impact and process evaluations and the different tasks that accompany each of these approaches to evaluation. Evaluation tasks Ms. Yaillen has been involved in include billing analysis, discrete choice analysis, development of logic models, documenting program history, survey instrument development, and survey data analysis.

For her work with SDG&E and SCG, Ms. Yaillen developed a logic model and program theory documents for the Single and Multifamily Rebate programs, the Lighting Exchange program, and Appliance Recycling program among many others. She assisted in the development of survey questions for these programs as well. As part of an impact evaluation for Energy Trust of Oregon she conducted a billing regression analysis to determine net program effects. Ms. Yaillen also has experience in analyzing survey data and using this to develop discrete choice models for the purpose of determining net-to-gross ratios for the Express Efficiency program.

### ***Experience evaluating programs in California***

The majority of Ms. Yaillen's evaluation experience has come from the evaluation of programs implemented in California. As listed above, she has assisted in evaluating multiple statewide programs and is currently involved in evaluation activities for the Statewide Express Efficiency program. Ms. Yaillen has also worked on the Statewide Residential, Non-residential, Express Efficiency, and Emerging Technology programs, and will work on the Small Commercial program evaluation among others in the near future.

Through working on these program evaluations Ms. Yaillen has become familiar with the CPUC protocols for both process and impact evaluations. She has had practice utilizing resources such as the EEGA website and DEER database, most recently for her work on the Express Efficiency program evaluation.

### ***Statistical analysis, specifically regression modeling and sampling***

Ms. Yaillen's primary evaluation work has been focused on statistical analysis and regression modeling. She has experience with billing regression techniques, as well as discrete choice analysis and nested logit models. She was the primary analyst for the Energy Trust of Oregon project listed above, and developed both an annual and monthly billing model to determine program impacts. This billing model was developed using pre- and post-program kWh usage to determine net impacts for the Home Energy Solutions program.

Ms. Yaillen is currently working on discrete choice modeling for the Express Efficiency program. She is creating separate models for linear lighting, CFLs and HVAC equipment that make use of survey data as well as program tracking data. Ms. Yaillen will do similar modeling for the '06-08 Small Commercial evaluation.

### ***Development of survey instruments and interviewing***

Ms. Yaillen has assisted in developing survey instruments for the Statewide Residential program evaluation as well as for the Home Energy Solutions program evaluation listed above. For the Home Energy Solutions program Ms. Yaillen was responsible for writing selected survey questions and editing the content and numbering for participant, non-participant, and contractor surveys.

Ms. Yaillen has had some experience with interviewing as well, conducting phone interviews with licensed architects for a green building program evaluation. These interviews involved asking detailed questions about architectural design practices in the Pacific Northwest and lasted about 30 minutes each.



## JESSICA SMITH

### Research Assistant, ECONorthwest

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#### EDUCATION

- B.A., Economics, Willamette University, Salem, OR (2007), Magna Cum Laude, Phi Beta Kappa

#### EMPLOYMENT HISTORY (1 YEAR PROFESSIONAL EXPERIENCE)

- Research Assistant, ECONorthwest, June 2007-Present
- Economic Stimulus Intern, Oregon Bridge Delivery Program, Spring 2007

#### SELECTED PROJECT EXPERIENCE

**SDG&E and SoCal Gas 2006-2008 Non-Residential and Residential Process Evaluation.** For SDG&E and Southern California Gas, Ms. Smith assisted on a wide range of tasks in the process evaluation for eight non-residential and 19 residential programs. Responsibilities included creating logic models and program theory, conducting in-depth interviews, site-visits, developing phone surveys, analyzing survey data, and report writing. In addition, Ms. Smith managed all evaluation work conducted for the residential Home Energy Efficiency Survey and Residential Customer Information and Education programs and the non-residential Codes and Standards program. These analyses and recommendations for program improvements will help with planning for the 2009-2011 program cycles.

**2007 NEEA ENERGY STAR Homes Process Evaluation.** The Northwest Energy Efficiency Alliance's ENERGY STAR Homes program promotes the construction and sale of new homes built to ENERGY STAR design specifications in Washington, Oregon, Idaho and Montana. For the 2007-2009 process evaluation, Ms. Smith conducted in-depth interviews with participating builders. This work benchmarks the program's progress and will also facilitate changes in program design in future years. Ms. Smith also assisted with data analysis in NEEA's 2004-2006 ENERGY STAR Homes process evaluation.

**2007 ETO Home Energy Solutions Process and Impact Evaluation.** The Energy Trust of Oregon's Home Energy Solutions program provides cash incentives to residential customers for energy efficient upgrades to their homes. Ms. Smith assisted with the analysis of survey results for participants and non-participants in the program. This analysis will help with planning future phases of the Energy Trust's residential initiative.

**NEEA Design & Construction Cross-Cutting Market of the Commercial Sector Initiative.** The Design & Construction program promotes the construction of high performance non-residential buildings through the practice of integrated design. For Design and Construction evaluation, Ms. Smith conducted in-depth interviews with architects. The Design and Construction program is still in its early phases and therefore the results of this process evaluation are critical to establishing the future direction of the program.

**NYSERDA Logic Models and Program Theory for New York Energy Smart Programs.** For NYSERDA, Ms. Smith developed logic models and program theory for the Clean Energy Infrastructure and Distributed Energy Resources programs.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Understanding of program evaluation theory.***

Ms. Smith is well-versed in program evaluation approaches, from the initial stages of logic models and program theory, through development of researchable issues and data collection instruments, data analysis, and report writing.

Ms. Smith has engaged in all these aspects of evaluation for the SoCal Gas and SDG&E residential and nonresidential projects in 2007. For these process evaluations, researchable issues were developed by studying program theory and engaging in discussions with program managers. As a result, the evaluations measured how well program activities produced the short-term and long-term outcomes dictated by program theory, such as how effectively the Home Energy Efficiency Survey program provoked the adoption of more energy efficiency behaviors and equipment purchases. In addition, the evaluation addressed the key challenges identified by program managers and implementers, such as the high cancellation rates occurring in the Appliance Recycling program. Surveys and in-depth interviews were conducted, and analysis of the resulting data implied suggestions for program improvements.

### ***Experience evaluating programs in California***

Ms. Smith has worked extensively on energy efficiency program process evaluations for Southern California Edison, San Diego Gas and Electric, and Southern California Gas energy utilities. She has assisted on a wide range of tasks in the process evaluation for eight non-residential and 20 residential energy efficiency programs, including developing logic models and surveys, conducting interviews and fielding surveys, analyzing data, and report writing.

### ***Development of survey instruments and interviewing***

Ms. Smith has developed both on-line and phone survey instruments for three utility Home Energy Efficiency Survey programs. The surveys measured the effectiveness of the program's on-line design, program impacts, and customer satisfaction. She has also written many in-depth interview guides and has experience conducting interviews with program managers, implementers, and participants.

Specifically, Ms. Smith has conducted numerous in-depth interviews for the SDG&E and SoCal Gas Codes and Standards program with industry stakeholders, California Energy Commission staff, and engineering consulting teams to document coordination among these groups. Moreover, for the NEEA ENERGY STAR Homes program, she has interviewed participant builders across Washington, Oregon, Idaho, and Montana in order to determine the effectiveness of the program's marketing, verification, and technical services. For NEEA's Commercial Initiative, Ms. Smith interviewed architects in multiple states in order to analyze the penetration of the NEEA Design & Construction program.



# LOGAN VAN ERT

## Research Assistant, ECONorthwest

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### EDUCATION

- B.A., Economics, Mathematics, Willamette University (2007)

### EMPLOYMENT HISTORY (1 YEAR PROFESSIONAL EXPERIENCE)

- Research Assistant, ECONorthwest, 2007-Present

### SELECTED PROJECT EXPERIENCE

**Energy Trust of Oregon Homes Energy Solutions (HES) Evaluation.** For Energy Trust, ECONorthwest will conduct an impact evaluation that will provide reliable estimates of therm and kWh savings, savings attributed to the implementation of energy efficiency measures in Oregon households (which ETO provides cash incentives for). Using these 2005-2006 estimates, ETO can more accurately allocate resources to future projects and budgeting. In addition, ECONorthwest will conduct a process evaluation to determine what improvements can be made to program design that will enhance delivery. Logan has assisted in the process evaluation by analyzing data for the participant, non-participant and vendor surveys fielded for this project.

**2006-2008 SDG&E and SCG Residential and Non-Residential Process Evaluation.** For SDG&E and SoCal Gas, ECONorthwest served as the lead process evaluator for the residential evaluation and an integral team member of the non-residential evaluation, which was headed up by KEMA. For both evaluations, Logan analyzed survey data for several of the residential and non-residential programs. He also developed a database in SPSS from survey responses for both utilities to assess the market potential for key measure groups. Additional responsibilities included editing of survey instruments and report writing.

### RELEVANT EXPERTISE AND QUALIFICATIONS

#### *Experience evaluating programs in California*

Logan has been involved in several process evaluations for California's IOU's. Logan has primarily been involved with SDG&E and SoCal gas residential and non-residential programs, such as Small Business Super Saver, Express Efficiency, Business Energy Assessment, and Single Family. Logan was extensively involved with the Business Energy Assessment program evaluation: reviewing survey instruments, uploading and monitoring the online participant survey, analyzing data from that survey, writing the report section and reviewing many of the materials ECONorthwest had for the project. In addition to these programs, Logan has also had extensive exposure to HEES (Home Energy Efficiency Survey) programs through projects contracted with SCE, SDG&E and SoCal Gas. Currently, Logan is updating the Market Characterization section of the Market Progress Evaluation Report (MPER) for Energy Star Homes Program evaluation. In general, Logan's primary evaluation activities include reviewing and editing project documents as well as analyzing survey data in SPSS and Excel. He analyzes frequencies of survey questions and creates pivot tables in an effort to uncover telling results. Subsequent to his data analysis, Logan has been responsible for incorporating relevant results from the data into report drafts.

***Development of survey instruments and interviewing***

Logan has had experience administering interviews through the TA/TI program, primarily participant in-depth interviews. Outside of energy evaluation, Logan has developed his own surveys and conducted personal interviews for an ECONorthwest client who was interested in finding out how feasible it would be to build an equestrian center in northern California. Logan researched the Oregon and California equestrian market, interviewing key staff at equestrian centers in Oregon and across the U.S.

## JOHN STEVENSON

### Survey Research Consultant

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#### EDUCATION

- B.A., Sociology with Concentration on Analysis & Research, University of Wisconsin-Madison (1988)
- Graduate Studies in Sociology and Survey Research Methods, University of Michigan- Ann Arbor (1989-1990)

#### EMPLOYMENT HISTORY (20 YEARS PROFESSIONAL EXPERIENCE)

- Associate Director, University of Wisconsin Survey Center, 2000-Present
- Project Director, University of Wisconsin Survey Center, 1994-1999
- Project Director, Wisconsin Department of Natural Resources, 1991-1994
- Independent Consultant and Data Analyst for CBS News and The New York Times 1990-1991
- Research Assistant, New York City Criminal Justice Agency 1988-1991

#### SELECTED PROJECT EXPERIENCE

**Home Energy Efficiency Survey (HEES) Program Evaluation.** As a subcontractor to ECONorthwest, Mr. Stevenson is providing methodological advice and consultation for the telephone and web surveys being conducted as part of the Home Energy Efficiency Survey program evaluation. Stevenson reviewed the prior evaluation studies and their results to improve upon previous work and to continue to increase the quality of these types of surveys. Stevenson drafted survey questions, and reviewed survey drafts through their iterations. Review includes consultation on question wording, response options, question flow and instrument ordering. Surveys are reviewed to maximize validity and reliability and assure highest data quality possible. Stevenson also reviewed survey methods and consulted on sampling, mode, and protocol of best practices to ensure high response rates and high data quality. Surveys were constructed for participants in several different programs targeted to reduce household energy use, focused on users of a variety of home energy audit programs.

**San Diego Gas & Electric & So Cal Gas Residential Program Process Evaluation.** As a subcontractor to ECONorthwest, Mr. Stevenson provided methodological advice and consultation for all the telephone surveys fielded as part of the 2006-08 process evaluations of all the SDG&E and SCG residential programs. Stevenson reviewed previous surveys and their results, drafted survey questions, and reviewed survey drafts through their iterations. Review includes consultation on question wording, response options, question flow and instrument ordering. Surveys are reviewed to maximize validity and reliability and assure highest data quality possible. Stevenson also reviewed survey methods and consulted on sampling, mode, and protocol of best practices to ensure high response rates and high data quality. Surveys were constructed for participants in several different programs targeted to reduce household energy use, focused on users of a variety of equipment types, demographics, and program characteristics.

**Wisconsin Public Service Commission Study of Low Income Landline Telephone Rates.** As Associate Director UW Survey Center, Stevenson conducted a large scale complex study of low income households and their telephone service. Study was done to evaluate how potential rate changes would effect low income households' access to telephone service. Study methodology had to be developed to ensure high response rate among stratified random sample of lowest income households. Sample size was N of 4,000, consisting primarily of minority and other hard-to-survey sub-populations. Stevenson was

responsible for survey methods and instrument design and implementation of the study. Study yielded better than 50% response rate.

**Wisconsin Longitudinal Study.** Stevenson is responsible for overall management, methods development and implementation of this gold standard longitudinal study. This project is moving forward from its fifth round of data collection for the Wisconsin Longitudinal Study (WLS). Response rates have been consistently in 82-94% range. The WLS began in 1957 with original data collection from 10,317 high school graduates in Wisconsin with subsequent data collection in 1964, 1975, and 1992. The most recent wave consisted of a 75-90 minute in-depth telephone interview and a follow-up 50 page mail survey with the more than 9600 surviving men and women in the original sample. A parallel phone and mail survey was conducted with 7150 randomly selected siblings of the graduates. A shorter telephone survey was conducted with spouses of graduates and siblings. Currently, the UW Survey Center is conducting a telephone survey with widows of graduates and widows of siblings.

The WLS is a unique, large-scale longitudinal study of adults and their families that covers nearly half a century of life. It is a valuable resource for research on aging, life course, inter-generational transfers, relationships, family functioning, long term effects of education and cognitive ability, occupational careers, physical and mental well-being, and morbidity and mortality. Most recently, UWSC conducted a massive biomarker collection for the Wisconsin Longitudinal Study. 8,141 graduates were asked to donate a saliva sample using an Oragene kit and return it by mail. With the success of this effort, UWSC will be fielding a similar biomarker collection effort with the siblings. WLS investigators plan to analyze the DNA in the saliva to study the relationship of genes to health and well-being, including Alzheimer's disease, cancer, and depression.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Development of survey instruments and interviewing***

John Stevenson has over 20 years of experience in the field of survey research. Mr. Stevenson has been Associate Director at the University of Wisconsin Survey Center (UWSC) since 1999, after serving as a Project Director for UWSC for five years. He has worked for an independent consultant for CBS News and The New York Times. He has also worked as a Senior Research Specialist for the Wisconsin Department of Natural Resources, conducting phone surveys, mail surveys and focus groups for policy makers. He has also worked as a private consultant conducting focus groups and developing survey instruments. He has managed hundreds of survey research project in his career on a very wide range of topics, primarily for university and state and federal government studies, but also for private companies.

He has received formal survey research training at the Universities of Wisconsin and Michigan; two of the top survey research schools in the country. For the past several years he has worked closely with colleague and Faculty Director Dr. Nora Cate Schaeffer, who is widely regarded as the leading national expert in survey question design.

Mr. Stevenson has overseen hundreds of survey research projects in his career. He has advised top scientists at the University of Wisconsin-Madison, known for its world class social scientists. He has consulted on survey design and survey research methods on projects throughout the university and also for top scientists at universities such as Columbia University, The University of Chicago, and Harvard University. He has extensive experience working on applied projects and program evaluation for state and federal government agencies.

Stevenson also brings a great deal of experience conducting focus group research. He has received training in conducting qualitative focus group research from leading national expert Dr. Richard Krueger. He has scripted and personally moderated focus groups on a wide range of topics for clients at several state agencies. While at the Wisconsin Department of Natural Resources, Stevenson conducted focus groups to evaluate and improve a wide variety of programs and policies. Since joining the University of Wisconsin,

he has conducted groups for program evaluation for a variety of state agencies and university administration. As a private consultant he has conducted groups for the private sector, including several on corporate image for American Family Insurance.

Mr. Stevenson will serve as a survey research consultant on the project. He will meet with team members to design survey instruments, and consult on all issues relating to survey design and implantation. His focus will be ensuring high data quality. This will entail ensuring that there is high quality design in all aspects of the survey research process, including wording of individual items, flow of survey instruments, developing appropriate answer categories, ordering of items, developing introductions, and all other aspects of the survey research instrument development.

## MICHAEL BAKER

Vice President, SBW Consulting, Inc.

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### EDUCATION

- B.S., Engineering, Interdisciplinary Engineering Studies, Purdue University, 1975.
- Graduate Studies, Civil Engineering, Social Management of Technology Program, University of Washington.

### EMPLOYMENT HISTORY (29 YEARS PROFESSIONAL EXPERIENCE)

- Principal, SBW Consulting, Bellevue, WA. 1990-Present
- Principal, BR Associates, Seattle, WA. 1983-1990
- Energy Specialist, Seattle Energy Office/Seattle City Light, Seattle, WA. 1979-1983

### SELECTED PROJECT EXPERIENCE

**Impact Evaluation of 2001 Commercial Water Conservation Programs.** Mr. Baker assisted in the developing the research design and implemented the pre/post sampling procedure for this evaluation of this major Saving Water Partnership/Seattle Public Utilities program (0.3 mgd claimed savings). The program sampled 25 measures including cooling towers, commercial washing machines, ice makers, and flush valve toilets. Estimates of savings were developed using short-term measurements of cumulative water use, equipment run time and event counts, and other performance parameters for a wide variety of technologies. From these savings estimates, SBW developed savings realization rates by water efficiency technology, which supported program-level gross savings estimates.

**Impact Evaluation of the Retro-Commissioning Contract Group.** SBW was retained by the California Public Utilities Commission to conduct an impact evaluation of ten highly varied retro-commissioning programs implemented by PG&E, SCE, SCG and SDG&E under the PY2006-08 program cycle. Mr. Baker has designed the evaluation and documented it in a detailed evaluation plan. Mr. Baker is currently managing the implementation of the evaluation plan. The evaluation will use a measurement-based approach to evaluate the energy and peak demand savings for a randomly selected sample of energy efficiency technologies implemented under these programs. Realization rates and net-to-gross ratios will be calculated for each sampled case. The gross and net savings will be extrapolated to the entire program population for each program. The evaluation concepts and design requirements of this program are very similar to the requirements of the embedded energy program.

**Evaluation, Measurement, and Verification of Statewide UC/CSU/IOU Energy Efficiency Partnership Program.** Mr. Baker is the project manager for SBW's evaluation of the Statewide UC/CSU/IOU Energy Efficiency Partnership Program (Program Years 2004 and 2005). This program is delivering energy efficiency retrofits and monitoring-based commissioning to buildings operated by University of California (UC) and California State University (CSU). This program is also delivering education and training to building operations staff. This evaluation will determine the kW, kWh and therm impacts associated with both the retrofit and commissioning projects. This will be accomplished by collecting baseline and post-improvement data from a sample of buildings treated by the program. Site-specific evaluation plans will be implemented, including short-term monitoring of affected systems. In addition, program and building operation staff will be interviewed to support an evaluation of program procedures and the effectiveness of the training program.

**Compact Fluorescent and Showerheads/Aerators Program Evaluations.** Mr. Baker was the project manager for SBW's evaluation of two DSM programs operated by Washington Water Power. The first evaluation determined the energy savings associated with a WWP rebate for compact fluorescent bulbs.

The second evaluation determined the energy savings from the installation of efficient shower heads and aerators. We also conducted a process evaluations for both programs. The process evaluation assessed the attitudes of participants, non-participants and trade allies and identify any needed changes in the operation of the program. Mail surveys were conducted with 1,200 customers to provide the data needed for these evaluations.

**PG&E's 1995 and 1996 Industrial Retrofit Program Evaluation.** Mr. Baker was the project manager for SBW's evaluation of the PG&E's 1995 and 1996 Industrial Energy Efficiency programs. More than 700 on-site surveys were conducted, along with extensive telephone surveys, to collect the data needed to support this evaluation. These evaluations determined the gross and net kWh, kW and Therm savings from each of four categories of efficiency measures: lighting, HVAC, process and miscellaneous. Project-specific evaluations of measure savings, based, as needed, on end-use metering of affected systems, were conducted for projects that accounted for 70 percent of the savings in the lighting, HVAC and process end uses, in each year. The estimates of net savings account for the project-specific effects of free-ridership and site-level spillover analysis. This study also produced a database of measure-specific equipment characteristics that will meet the needs of future measure retention studies.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Understanding of program evaluation theory***

For 15 years Mr. Baker has been very heavily involved in the design of complex energy and water program evaluations in California and Washington. From this experience he has gained a very thorough understanding of impact evaluation theory as applied to a variety of water and energy programs in the commercial and industrial areas. His most recent experience in California involves the evaluation of ten retro-commissioning programs for the CPUC. From this work he has gained a thorough understanding of the most recent California Evaluation Protocols and the practical application of the general protocols to a variety of specific commercial/industrial programs in the 2006-08 program cycle.

### ***Experience evaluating programs in California***

Recent evaluation projects of particular relevance to this proposal include the following:

1. Impact and process evaluation of California 2004-5 UC/CSU/IOU Energy Efficiency Partnership.
2. Impact evaluation of Oakland (California) Energy Partnership 2002-03 BEST program.
3. Impact and process evaluation of the PG&E 1995 Industrial Retrofit program.
4. Impact and process evaluation of the PG&E 1996 Industrial Retrofit program.
5. Impact and process evaluation of the PG&E 1994 Commercial HVAC Retrofit program.

### ***Statistical analysis, specifically regression modeling and sampling***

Mr. Baker has been responsible for developing sample designs for commercial and industrial sector market research and EM&V studies for more than 20 years. He was responsible for design and implementation of two stage cost-optimized sample, including first stage geographic clusters, for the BPA Pacific Northwest Non-Residential Energy Survey. He was responsible for development of optimized sample designs for a number of large scale California EM&V programs. In our current CPUC evaluation of Retro-commissioning and Major Commercial programs, Mr. Baker is currently designing and implementing sampling for 16 programs, some of which will involve a complex combination of pre/post and post-only designs.

***Coordination and management of evaluation work*** – Mr. Baker has been the project manager for many of the evaluations that he has participated in over the last 15 years. He is currently the project manager for



the impact evaluation of 10 retro-commissioning programs for the CPUC. From this experience he has developed positive relationships with program managers at the CPUC and at the participating energy and water utilities. He has also gained a detailed understanding of the complex logistics that are involved in performing large and complex projects for clients that involve utility/government partnerships and require the use of multiple consultant teams.

***Collection and analysis of metering data***

Mr. Baker has conducted analyses of interval demand data throughout his 28-year career. This started with analysis of multiple years of hourly billing data for more than 200 commercial customers of Seattle City Light to deduce daytypes for different classes of commercial buildings. He developed two software packages for analyzing interval data: Load Profiler and LogTool. These have been used to analyze load shape both for premise level and system level power measurements from both commercial and industrial facilities. LogTool is capable of both time-series and scatter plot analysis of intervals ranging from one second to one day. He was responsible for the design of BPA's Commercial Building Base Study, under the End Use Loads and Conservation Assessment project, in which comprehensive end use power measurements were collected for 100 buildings.

***Energy test instruments and procedures***

Mr. Baker has played a major role in the design and development of a wide variety of instruments and procedures used in collecting site, end-use and measure specific data from many types of commercial, industrial and residential facilities. These include methods that range from very detailed equipment metering systems for compressed air systems to executive survey instruments that collect detailed data from decision-makers, vendors and operations staff related to the analysis of free-ridership and spillover.

***Experience working with implementers to ensure program evaluability***

In all five evaluation projects listed above, Mr. Baker worked closely with implementers, while the programs were ongoing, to coordinate key aspects of the evaluations and to collect adequate baseline data.

***Experience with pre and post measurement and analysis, specifically collecting pre-data***

As highlighted in previous paragraphs, Mr. Baker has extensive experience collecting pre and post data for both water and energy efficiency evaluations. He is acutely aware of the particular challenges of baseline data collection, and established an innovative method for doing so for one of the pre-rinse spray valve evaluations.



## MARC SCHULDT

Principal, SBW Consulting, Inc.

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### EDUCATION

- M.S., Mechanical Engineering, University of Washington, Seattle WA (1978)
- B.A., Aeronautical Engineering, Purdue University, West Lafayette, Indiana (1973)

### EMPLOYMENT HISTORY (29 YEARS PROFESSIONAL EXPERIENCE)

- Principal, SBW Consulting, Inc., 1990-Present
- United Industries, 1982-1990
- Mathematical Sciences NW, 1978-1982

### SELECTED PROJECT EXPERIENCE

**Impact and Process Evaluation of the Water Smart Technology Water Conservation Program.** For Seattle Public Utilities, Mr. Schuldt designed and managed a process and impact evaluation of the 2001 Water Smart Technology (WST) program, one of the largest programs in the Pacific Northwest. For the impact portion of the work, a detailed engineering analysis was performed of a randomly selected sample of implemented measures. Measure-specific evaluation plans were prepared and carried out for this sample, resulting in evaluation estimates of gross savings. Estimates were based on short-term measurements of cumulative water use, equipment run time and event counts, and other performance parameters for a wide variety of technologies, such as cooling towers, commercial washing machines, ice makers, irrigation controls and flush valve toilets. These evaluation estimates were compared to those prepared by program staff and the reasons for major differences were identified. Both sets of estimates were used to develop savings realization rates for the measures. These realization rates were applied to program savings for all projects completed in 2001 to develop estimates of program-level gross savings.

**Impact Evaluation of the Major Commercial Contract Group.** SBW was retained by the California Public Utilities Commission to conduct an impact evaluation of six non-residential energy conservation programs implemented by SCE, SCG and SDG&E under the PY2006-08 program cycle. Mr. Schuldt has designed the evaluation and documented it in a detailed evaluation plan. Mr. Schuldt is currently managing the implementation of the evaluation plan. The evaluation will use a measurement-based approach to evaluate the energy and peak demand savings for a randomly selected sample of energy efficiency technologies implemented under these programs. Realization rates and net-to-gross ratios will be calculated for each sampled case. The gross and net savings will be extrapolated to the entire program population for each program. The evaluation concepts and design requirements of this program are very similar to the requirements of the embedded energy program.

**Single Family Water Fixture Energy-related Measurements.** SBW was retained by Seattle Public Utilities and Seattle City Light to investigate the energy-related flows of water fixtures in a representative sample of single-family residences in the City of Seattle. Mr. Schuldt designed and managed this project. SBW took water and energy performance measurements of showerheads, faucet aerators and toilets in 71 single-family homes. SBW also acquired other useful data on characteristics of water appliances in the sampled homes. The resulting data was analyzed to determine current baseline conditions in Seattle and the site-level water and energy impact of more efficient water fixtures.

**Urinal Baseline Study.** Mr. Schuldt designed and managed a recently completed a study for the Seattle Saving Water Partnership that examined the baseline performance characteristics of the existing urinal stock and assessed the practicality and cost-effectiveness of alternative strategies to significantly reduce water consumption and maintain flush effectiveness. The study determined baseline characteristics of the

existing stock of urinals as well as urinal flush volume and flush effectiveness through field measurements. The study also included interviews with commercial customers on maintenance practices and urinal performance history. The study identified possible urinal efficiency improvements that are practical and cost-effective and evaluated them for applicability and practicality through a series of field tests. The study resulted in a series of recommendations for the design of a future program.

**Assessment of Water and Energy Savings for Efficient Showerheads and Faucet Aerators.** SBW collected and analyzed data on the impact of efficient shower heads and faucet aerators on a sample of 80 single family residences and more than 90 multifamily units in the Pacific Northwest. Mr. Schuldt designed and managed this project. The pre/post research design involved baseline data collection, followed by the installation of efficient shower heads and aerators, followed by a post-installation metering period. A variety of one-time measurements of water temperatures and flow rates were taken along with continuous monitoring of flow volumes and energy use during the pre and post periods. The results of the study included estimates of energy and water savings for each conservation measure installed in the participating dwellings.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Understanding of program evaluation theory***

For 15 years Mr. Schuldt has been very heavily involved in the design of complex energy and water program evaluations in California and Washington. From this experience he has gained a very thorough understanding of impact evaluation theory as applied to a variety of water and energy programs in the commercial, industrial and multifamily sectors. His most recent experience in California involves the evaluation of six commercial/industrial programs for the CPUC (Major Commercial contract group). From this work he has gained a thorough understanding of the most recent California Evaluation Protocols and the practical application of the general protocols to a variety of specific commercial/industrial programs in the 2006-08 program cycle.

### ***Experience evaluating programs in California***

Mr. Schuldt has been evaluating commercial and industrial energy programs in California for 15 years. His experience began with the impact evaluation of PG&E's 1992-93 Commercial New Construction programs. The study determined both the gross and net kWh and demand impact of the program through a combination of engineering and statistical techniques that were consistent with the EM&V protocols in place at the time. Since then he has been involved in numerous commercial/industrial program evaluations for PG&E and additional evaluations (energy and water) for third parties during the 2004/04 and 2005/06 program cycles. Most recently he has been heavily involved in the evaluation of six commercial/industrial programs for the CPUC (Major Commercial contract group).

### ***Energy modeling, specifically energy engineering principles and simple engineering models***

Mr. Schuldt has managed numerous non-residential impact evaluations that have assessed the energy and peak demand impacts of program measures on large commercial buildings and industrial facilities. In all cases the assessments of energy and demand savings by SBW staff were based on the application of sound engineering principals for all of the affected end uses. These principals were allied equally to both simplified spreadsheet analyses and more complex simulation analyses. For each evaluation, Mr. Schuldt worked closely with SBW staff to ensure that the most appropriate level of analysis was selected and that these principals were properly applied. Internal peer review of all major deliverables was also used as a means of ensuring that the most appropriate analysis techniques were applied.

### ***Coordination and management of evaluation work***

Mr. Schuldt has been the project manager for most of the evaluations that has participated in over the last 15 years. He has also been the project manager for numerous water and energy technology assessments that have been performed by SBW over the last 18 years. He is currently the project manager for the impact evaluation of six commercial/industrial programs for the CPUC (Major Commercial contract group). From this experience has developed positive relationships with program managers at the CPUC and at the participating energy and water utilities. He has also gained a detailed understanding of the complex logistics that are involved in performing large and complex projects for clients that involve utility/government partnerships and require the use of multiple consultant teams.

### ***Experience working with local water agencies, especially evaluating water conservation programs***

Mr. Schuldt was the project manager for the impact evaluation of the Water Smart Technology program, operated by Seattle Public Utilities. He was also the project manager for the impact evaluation of two third party programs in California that involved the assessment of both water and energy savings for pre-rinse spray valves in food service establishments. He has also managed the implementation of programs in Washington and Arizona that have installed conservation measures that save both water and energy. In all cases he has developed relationships with local and state water agencies that sponsored the projects and worked directly with them to design and successfully execute them.

### ***Overall experience in the water field in California***

SBW has performed impact evaluations of two third party water/energy conservation programs whose implementation was funded by the CPUC. They involved the estimation of program level impacts for pre-rinse spray valves for the 2002/03 and 2004/05 program cycles.

### ***Experience working with implementers to ensure program evaluability***

An important part of most impact evaluations that Mr. Schuldt has managed in providing early feedback to the implementers that will assist them in improving the efficiency and effectiveness of program delivery. This has been especially true for programs that have low realization rates. Early feedback can significantly improve the ability of the implementer to prepare realistic ex ante estimates for future measures.

### ***Experience with pre and post measurement and analysis, specifically collecting pre-data***

SBW promotes the use of pre/post analysis in all of the program evaluations that they design, if the ability to collect baseline data is possible. Pre/post measurements often produce savings results that are not expected or intuitive – improving the accuracy of the savings estimates. However, a pre/post design does introduce some complexities such as the need for closer tracking of project status and the careful consideration of pre-retrofit measurements so that data is not collected for projects that are committed but ultimately are not implemented

## **BEN WILDMAN**

**Principal, SBW Consulting, Inc.**

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### **EDUCATION AND REGISTRATION**

- Professional Engineer, Civil Engineering, Washington (1989)
- Wastewater Treatment Plant Certification Level IV, Washington (1986)
- B.S., Chemical Engineering, University of Colorado (1974)

### **EMPLOYMENT HISTORY (26 YEARS PROFESSIONAL EXPERIENCE)**

- Principal, SBW Consulting, Inc., 1990-Present
- Sole Proprietor, Wildman Consulting, 1989-1990
- Process Analyst/Project Manager, Municipality of Metropolitan Seattle, 1982-1988
- Environmental Engineer, Kramer, Chin and Mayo, Inc., 1979-1982

### **SELECTED PROJECT EXPERIENCE**

**Municipal Water Treatment Plant Baseline Energy Study.** Mr. Wildman was the primary author of the baseline energy study for the Pacific Gas & Electric Company (PG&E). The study provided an overview of current and pending regulations for municipal water treatment facilities. In addition, the study contained an overview of the treatment processes and their associated energy requirements for treating ground water, surface water and brackish water. Technologies and associated energy consumption for disinfection was one area of particular focus. A brief survey was conducted of a few municipal water treatment agencies to obtain information regarding current practices and strategies for complying with pending regulations.

**Assisted with Audit of Corvallis Filter Plant and Taylor Water Plant.** Mr. Wildman was a team member conducting an audit of the Corvallis Filter Plant and Taylor Water Plant. Several energy efficiency measures were identified, including replacing a 2-stage pump with a single speed pump, improving pump sequencing, and eliminating the use of a throttling valve used to achieve mixing.

**Water Conservation at Wastewater Treatment Plants.** Both Pacific Power and PG&E have retained Mr. Wildman to conduct assessments of energy savings opportunities at several wastewater treatment plants. One area of resource and energy savings Mr. Wildman identifies during these projects is water consumption. For example, in one plant potable water was being used to wash down process tanks.

That procedure was subsequently discontinued and process tanks are now washed down with the use of treated water. At another facility, a hose-bib was usually left with water flowing freely. This procedure was discontinued.

**Benchmarking Study on Energy Use of Ultraviolet Disinfection in Wastewater Treatment.** Mr. Wildman was the primary author of a benchmarking study in which energy use data was collected at three wastewater treatment plants and a literature review provided additional data for benchmarking the use of ultraviolet radiation for achieving disinfection of wastewater. This work was extremely valuable in providing background knowledge of the UV process, which was used later in the water treatment plant baseline study.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Understanding of program evaluation theory***

Mr. Wildman was the project manager and lead engineer for the evaluation of two Third Party energy efficiency implementation programs in California. One evaluation was on a 2002-03 implementation program. Mr. Wildman was subsequently selected to evaluate the continuation of that program, the 2004-2006 program. Mr. Wildman will also be the lead engineer responsible for evaluating site-specific energy impacts of the wastewater treatment plants included in the 2006-08 programs to be evaluated by the PG&E Industrial and Fabrication contract group.

### ***Experience evaluating programs in California***

See the previous item.

### ***Energy modeling, specifically energy engineering principles and simple engineering models***

Mr. Wildman developed a computer model of a pilot scale sludge drying facility at the West Point Wastewater Treatment Plant. The model addressed two key areas, the energy and mass balances for the process. The model was used by the operations staff for both training and operating the test facility. The model provided one way for operators to ‘see’ the impact of a change in the moisture level of the feed material to the dryer performance and its energy use.

### ***Development of survey instruments and interviewing***

As the project manager for an evaluation of a technical 2004-2006 California implementation program, Mr. Wildman was deeply involved with the development of the interview instrument. The survey was conducted on wastewater treatment plant staff. As the specialist on the team on wastewater treatment Mr. Wildman had an important role in ensuring the survey had the correct and appropriate language.

### ***Experience with water monitoring and control equipment***

Mr. Wildman has considerable experience in monitoring flows and many aspects of control systems for equipment used in the wastewater treatment industry.

### ***Experience with the energy management and control systems of water agencies, specifically calculating energy use of pumps or treatment facilities***

Mr. Wildman has conducted an energy audit at more than a dozen wastewater Treatment facilities. Those audits involved assessing pumps and pump controls that move large volumes of water, filter systems, disinfection processes and other unit processes that have similarities to water treatment equipment and facilities.

### ***Experience with water systems analysis including physical and engineering principles***

Mr. Wildman has extensive experience analyzing physical and engineering principles in evaluating energy use and energy savings at wastewater treatment facilities and in evaluating physical and biological processes.

### ***Collection and analysis of metering data***

Mr. Wildman has considerable experience installing metering equipment, collecting and analyzing energy data as well as parameters that indicate water and wastewater quality.

***Energy test instruments and procedures***

Mr. Wildman has installed various metering equipment including Micro-Data Loggers, power meters, current transducers, as well as other instruments such as dissolved oxygen sensors and ph meters.

***Energy audit fieldwork***

Mr. Wildman has conducted more than a dozen audits on wastewater treatment plants. He has also conducted numerous reviews of energy savings analyses performed by other engineers.

***Experience working with implementers to ensure program evaluability***

Mr. Wildman has completed two evaluations of wastewater treatment programs in California that involved pre/post measurement designs. He stayed in close touch with the program implementers as the program was marketed to customers so that he could select appropriate samples for sites prior to their implementing improvements. He then took full advantage of data collected by the program and added strategically to this data collection to develop good information on baseline and as-built conditions. Site visits both before and after project implementation were critical to his development of a complete picture of what happened in each of these complex projects.

***Experience with pre and post measurement and analysis, specifically collecting pre-data***

Mr. Wildman has collected both pre- and post-implementation data for several of the EM&V projects he has conducted. This has included measurement of critical system and plant performance parameters, obtained from plant records and control systems and data obtained thru the installation of special metering equipment.



## **BING TSO, P.E., LEED AP**

**Senior Project Manager, SBW Consulting, Inc.**

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### **EDUCATION**

- B.S., Mechanical Engineering, Stanford University, Stanford, CA (1986) – graduated with distinction; elected to Phi Beta Kappa.

### **EMPLOYMENT HISTORY (22 YEARS PROFESSIONAL EXPERIENCE)**

- Senior Project Manager, SBW Consulting, Inc., 1994-Present.
- English Instructor, Southern Institute of Metallurgy, Ganzhou, P.R. of China, 1991-1993.
- Systems Engineer, Pacific Gas and Electric Company, 1986-1991.

### **SELECTED PROJECT EXPERIENCE**

#### **Impact evaluations of water/energy savings from 2002-05 CUWCC pre-rinse spray head program.**

Mr. Tso was the project manager and technical lead for the evaluations of Phases 1 and 2 of a statewide natural gas and water conservation program for the California Urban Water Conservation Council (CUWCC) and CPUC. This program resulted in the installation of over 30,000 high-efficiency dishwashing pre-rinse spray heads in California food service establishments. The combined studies involved 200 telephone surveys and nearly 700 visits to randomly-selected sites to assess spray head retention and customer satisfaction, as well as measure flowrates and temperatures. In addition, for about 50 sites, Mr. Tso oversaw pre/post short-term water use metering. These data supported statistical and engineering calculations of overall program water/energy savings and cost-effectiveness.

**Impact Evaluation of 2001 Commercial Water Conservation Programs.** Mr. Tso was the technical lead for this evaluation of this major Saving Water Partnership/Seattle Public Utilities program (0.3 mgd claimed savings). The program sampled 25 measures including cooling towers, commercial washing machines, ice makers, and flush valve toilets. Mr. Tso was responsible for estimating savings using short-term measurements of cumulative water use, equipment run time and event counts, and other performance parameters for a wide variety of technologies. From these savings estimates, SBW developed savings realization rates by water efficiency technology, which supported program-level gross savings estimates.

**M&V support for Pacific Northwest Efficient Spray Head Installation Programs.** SBW designed and is currently overseeing highly successful direct install programs for Puget Sound Energy, Saving Water Partnership, Cascade Water Alliance, Seattle City Light, and Avista. These programs have installed nearly 11,000 high-efficiency dishwashing spray heads and thousands of aerators in food service establishments throughout Washington since 2003. As part of the effort, program installers have been collecting energy- and water-efficiency-related characteristics information from each facility they visit. In addition, the utilities requested end-use metering of 35 installations to verify savings, which Mr. Tso coordinated. He also combined measured results from these programs with results from other programs and tests performed throughout North America to establish the first comprehensive measurement-based assessment of water savings from this technology.

**Measurement-based commercial/industrial water audits in Hillsboro, Oregon.** Beginning in 2004, Mr. Tso performed water conservation audits, sponsored by the City of Hillsboro Water Department, at four elementary schools and three semiconductor manufacturing plants. The latter represented the utility's largest customer. These studies included water/sewer billing analysis, onsite data collection with selected one-time measurements of baseline consumption, and cost-benefit analysis for promising water-saving measures. The work yielded numerous cost-effective measures, some of which the customers implemented immediately.

**Measurement-based commercial water audits in Seattle, Washington.** Mr. Tso performed extensive measurement-based water efficiency studies for two medical research centers and two large hotels for Seattle Public Utilities in 1999. One, Fred Hutchinson Cancer Research Center, was selected for a citywide conservation award in 2002, in part because of the water conservation recommendations in Mr. Tso's study. These studies encompassed a wide range of end use technologies, including sterilizers, washers, film developers, medical air compressors, and waste heat recovery systems.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Experience evaluating programs in California***

Recent evaluation projects of particular relevance to this proposal include the following:

1. Impact evaluation of California Urban Water Conservation Council 2002-3 (Phase 1) pre-rinse spray valve distribution program.
2. Impact evaluation of California Urban Water Conservation Council 2004-5 (Phase 2) direct-install pre-rinse spray valve distribution program.
3. Impact evaluation of California 2004-5 Building Tune-up (BTU) Program.
4. Impact evaluation of California 2004-5 UC/CSU/IOU Energy Efficiency Partnership.
5. Impact evaluation of Oakland (California) Energy Partnership 2002-3 BEST and Building Tune-up.

### ***Energy modeling, specifically energy engineering principles and simple engineering models***

In all of the recent projects cited above, Mr. Tso has served as a lead engineer, collecting and analyzing pre and post data for a wide variety of commercial and industrial energy efficiency measures. These measures have included relatively simple measures, such as lighting modifications and efficient commercial pre-rinse spray valves, to complex retrocommissioning HVAC control changes in large buildings and central plants, such as temperature setbacks and optimized equipment staging. He has studied measures in new construction, retrofit and retrocommissioning projects, using data obtained from inspection, data loggers, customer control systems trend logs and interviews with plant and facility staff. He has developed numerous spreadsheet-based engineering models to compute efficiency measure energy savings. These models, in many cases, combined careful summarizations of thousands of data points; extrapolations to typical weather, operational conditions, and production levels; and calculation of annual and on-peak kWh savings, maximum and average peak period kW demand reduction, and annual therm savings.

### ***Statistical analysis, specifically regression modeling and sampling***

Mr. Tso has developed and implemented simple and stratified random sampling schemes to support the five evaluation projects listed above.

### ***Coordination and management of evaluation work***

For all five of the evaluation projects listed above, Mr. Tso played an important management role. For Projects #2 and #3 in particular, he was the project manager, responsible for developing the evaluation plan, marshaling the resources (including subcontractors) to accomplish the work, coordinating the work and progress of in-house staff and subcontractors, and reporting progress and negotiating scope adjustments with client project managers and CPUC staff. All five evaluations were completed successfully, on schedule, and within budget.



***Experience working with local water agencies, especially evaluating water conservation programs***

Mr. Tso has extensive professional connections with water conservation professionals and their agencies throughout the Pacific Northwest and beyond. These include formal contractual arrangements with agencies such as Seattle Public Utilities, Saving Water Partnership, Tacoma Water, City of Hillsboro Water Department, and Cascade Water Alliance. In addition, Mr. Tso has established numerous informal contacts through his active membership in the water conservation committee of the Pacific Northwest Section of the American Water Works Association (PNWS-AWWA) and the Partnership for Water Conservation (which covers the Central Puget Sound region of Washington State). He frequently presents papers and gives talks at local, regional, and national water conservation conferences and meetings.

***Experience with the energy management and control systems of water agencies, specifically calculating energy use of pumps or treatment facilities***

Mr. Tso has performed several comprehensive metering-based energy efficiency analyses for PacifiCorp, a Pacific Northwest energy utility. These studies included new and existing municipal water treatment plants, as well as a municipal wastewater treatment plant. Recommended measures, based on combinations of customer trend data from their EMCS and SBW metering data, highlighted ways to improve pumping efficiency through variable speed drives and process optimization.

***Water audit fieldwork***

In Mr. Tso's 18 years of experience as an engineering analyst and a systems engineer, he has performed dozens of water and energy efficiency studies of commercial and industrial facilities. As the Selected Project Experience highlights, he has performed comprehensive water audits at schools, hospitals, research facilities, and semiconductor plants. He has also done water audits at restaurants, hotels, and other small businesses.

***Collection and analysis of metering data***

Mr. Tso's extensive experience auditing and evaluating a wide range of commercial facilities also require a high level of metering skills. For the majority of facilities he visited, he collected numerous channels of disparate data (kW, amps, flow pulses, temperatures, pressures, and time of use, for instance) with a wide range of sampling intervals. He is very proficient with aggregating, cleaning, summarizing these data to facilitate engineering analysis of energy savings. As part of these efforts, Mr. Tso often incorporated weather data, and developed the statistical correlations and/or bin analysis necessary to adjust metered data to account for typical conditions.

***Energy test instruments and procedures***

Mr. Tso has installed simple data loggers in more than 100 commercial and industrial facilities, both in support of M&V and impact evaluation studies and as part of energy and water efficiency audits. He has installed light, motor, temperature, relative humidity, pulse, and amp loggers on a wide variety of systems. He has been responsible for specifying measurement plans and analyzing logger data both for loggers he has installed and those installed by other staff. He is an expert in data cleaning, summarization and graphical analysis of logger data, and incorporating summarized data in calculations of energy impacts.

***Energy audit fieldwork***

Mr. Tso has completed about 30 commercial building audits of retail, office, and educational facilities. These audits generally included comprehensive assessments of lighting, HVAC, and miscellaneous equipment energy use through observations, measurements, drawing takeoffs, and interviews with occupants and facility operators. From this information, he prepared cost-benefit analyses and reports that

explained and prioritized recommended actions. Mr. Tso had complete responsibility for all data collection, savings analysis and report writing for these audits.

***Experience working with implementers to ensure program evaluability***

In all five evaluation projects listed above, Mr. Tso worked closely with implementers, while the programs were ongoing, to coordinate key aspects of the evaluations and to collect adequate baseline data.

***Experience with pre and post measurement and analysis, specifically collecting pre-data***

As highlighted in previous paragraphs, Mr. Tso has extensive experience collecting pre and post data for both water and energy efficiency evaluations. He is acutely aware of the particular challenges of baseline data collection, and established an innovative method for doing so for one of the pre-rinse spray valve evaluations.

## **SHEFALI MODI, M.S. ARCH., LEED AP**

**Water and Energy Conservation Analyst, SBW Consulting, Inc.**

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### **EDUCATION**

- M.S. Arch., Building and Environmental Technology, University of Michigan-Ann Arbor (2002) - Non-Resident Architecture Merit Scholar (2002)
- B.Arch., University of Mumbai, Mumbai, India (2001) – graduated First Class with Honors

### **EMPLOYMENT HISTORY (8 YEARS PROFESSIONAL EXPERIENCE)**

- Analyst, SBW Consulting, Inc., 2005-Present
- Project Manager, Hescong Mahone Group, Inc., 2003-2005
- Assistant Architect, Dara B. Mistry and Partners, 2000-2001

### **SELECTED PROJECT EXPERIENCE**

**2007 Seattle Urinal Baseline Study.** Ms. Modi was the project manager for a urinal baseline study for the Seattle Saving Water Partnership. The study examined the baseline performance characteristics of the existing urinal stock, such as equipment features, flush volume and flush effectiveness. It also assessed the practicality and cost-effectiveness of alternative strategies to significantly reduce water consumption and maintain flush effectiveness. The study included interviews with commercial customers on maintenance practices and urinal performance history. The study resulted in a series of recommendations for urinal efficiency improvement options that will form the basis for the design of a future program.

**2006-2007 Seattle Public Utilities Water Conservation Technical Assistance.** Ms. Modi was one of the technical leads for the technical assistance provided to large commercial and industrial customers of the Seattle Public Utilities. The assistance included water conservation audits, implementation of water conservation measures, and assistance with outreach and verification of water savings. Buildings treated include medical/dental facilities, hospitals, colleges, large hotels, a concert hall and a port facility. Technologies considered include cooling tower efficiency improvements; onsite steam condensate reuse; pre-rinse spray heads; efficient restroom and commercial kitchen water fixtures; hotel laundry water efficiency improvements; efficient laboratory and hospital equipment; and water brooms.

**2006 Tacoma Water Conservation Assessment.** Ms. Modi was the lead analyst for the development of a water conservation program assessment for Tacoma Water. The assessment provided information and guidance on implementing programs that support their long-term water conservation goals, including meeting the state requirement for a 10% reduction in water use. 40 water conservation technologies were evaluated for energy and water savings, cost effectiveness and sector impacts. 20 high priority measures were selected to assess the impact on residential and commercial water usage. The assessment created a series of alternative conservation program scenarios that varied in their cost and impact. These scenarios were to form the basis for future program planning.

**2004-2005 CUWCC Pre-rinse Spray Valves Savings Evaluation.** Ms. Modi was the lead analyst for the evaluation of Phase 2 of a statewide natural gas and water conservation program for the California Urban Water Conservation Council (CUWCC) and CPUC. This program resulted in the installation of over 30,000 high-efficiency dishwashing pre-rinse spray heads in California food service establishments. The combined studies involved 200 telephone surveys and nearly 700 visits to randomly-selected sites to assess spray head retention and customer satisfaction, as well as to measure flowrates and temperatures. These data supported statistical and engineering calculations of overall program water/energy savings and cost-effectiveness.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Experience evaluating programs in California***

Recent evaluation projects of particular relevance to this proposal include the following:

1. Impact evaluation of SDG&E/Comverge Demand Response Capacity Delivery Agreement 2007 - a performance based estimate of demand reduction.
2. Impact evaluation of California Urban Water Conservation Council (CUWCC) 2004-5 (Phase 2) direct-install pre-rinse spray valve distribution program.
3. Impact evaluation of California 2004-5 Building Tune-up Program.
4. Impact evaluation of California 2004-5 UC/CSU/IOU Energy Efficiency Partnership.
5. California Standard Performance Contract Summer Initiative program 2005 and Large Standard Performance Contract program 2004-5
6. Evaluation of the 2003 Energy Efficiency free CFL distribution program for the City of Davis.

### ***Energy modeling, specifically energy engineering principles and simple engineering models***

In the projects listed above Ms. Modi has performed the work of a lead analyst responsible for collection and analysis of both pre and post data for a wide variety of energy efficiency measures. These measures include lighting modifications, envelope improvements and equipment operational changes at residential, commercial, and industrial facilities, for both new construction and retrofit projects. She has used data from inspection, data loggers, customer control system trend logs, plans and interviews, to develop numerous spreadsheet-based engineering models to compute energy savings. These models, in many cases, combined careful summarizations of thousands of data points; extrapolations to typical weather, operational conditions, and production levels; and calculation of annual and on-peak kWh savings, maximum and average peak period kW demand reduction, and annual therm savings. In addition Ms. Modi is very familiar with Micropas and EnergyPro - tools certified by the California Energy Commission for creating energy models for Title 24 code compliance.

### ***Statistical analysis, specifically regression modeling and sampling***

Ms. Modi has developed and implemented simple and stratified random sampling schemes to support the first five evaluation projects listed above.

### ***Development of survey instruments and interviewing***

Ms. Modi developed the questionnaire used to interview facility managers for the urinal baseline study discussed earlier. She has conducted numerous residential interviews for the CFL distribution evaluation for the City of Davis and was commended on her ability to reach hard to reach customers. In addition, for a NEMA premium motor market assessment for the Sacramento Municipal Utility, Ms. Modi developed an interview guide, interviewed suppliers and manufacturers and translated interview records for statistical analysis.

### ***Experience working with local water agencies, especially evaluating water conservation programs***

Ms. Modi has extensive professional connections with water conservation professionals and their agencies throughout the Pacific Northwest and beyond. These include formal contractual arrangements with agencies such as Seattle Public Utilities, Saving Water Partnership, and Tacoma Water. In addition, Ms. Modi has established numerous informal contacts through her active membership in the water conservation committee of the Pacific Northwest Section of the American Water Works Association (PNWS-AWWA) and the Partnership for Water Conservation (which covers the Central Puget Sound

region of Washington State). She frequently presents papers and gives talks at local, regional, and national water conservation conferences and meetings.

#### ***Water audit fieldwork***

Ms. Modi has performed dozens of water and energy efficiency studies of commercial and industrial facilities. As the Selected Project Experience highlights, she has performed comprehensive water audits at schools, hospitals, research facilities, restaurants, hotels, and other small businesses.

#### ***Collection and analysis of metering data***

Ms. Modi has collected and analyzed interval energy and water metering data in her impact evaluations for several of the projects discussed earlier. She is proficient with aggregating, cleaning, and summarizing these data to facilitate engineering analysis of energy savings. Methods used have included time-series plots of multiple parameters to investigate their interactions, scatter plots to determine relationships between specific parameters and numeric techniques such as developing correlations between dependent and independent variables, quantifying time-based load profiles and performing various statistical analyses. As part of these efforts, Ms. Modi often incorporated weather data, and developed the statistical correlations and/or bin analysis necessary to adjust metered data to account for typical conditions.

#### ***Energy test instruments and procedures***

Ms. Modi has worked with simple data loggers in about 10 commercial and industrial facilities, both in support of M&V and impact evaluation studies and as part of energy and water efficiency audits. She has used light, motor and temperature loggers. She was responsible for the impact analysis of nine projects for the evaluation of the California 2004-5 UC/CSU/IOU Energy Efficiency Partnership. She has developed and implemented a data collection plan incorporating data loggers and trended data from on-site controls systems as well as information obtained from site personnel in interviews. Her responsibilities include data analysis and report preparation for each site

#### ***Energy audit fieldwork***

Ms. Modi has gained extensive understanding of the energy performance characteristics of many commercial building end uses including lighting, HVAC, and motors. Her experience includes energy efficiency audits in about 10 commercial facilities in which she performed both data collection and energy savings analyses. She has also conducted data collection and savings calculations for efficiency measures in about 10 commercial facilities for impact evaluation studies.

#### ***Experience with pre and post measurement and analysis, specifically collecting pre-data***

For the projects discussed above, Ms. Modi has collected pre and post data for both water and energy efficiency evaluations.

## **RANDY BIRK**

**Technician, SBW Consulting, Inc.**

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### **EDUCATION**

- High School Diploma, Elkhart High School, Elkhart, Indiana (1972)

### **EMPLOYMENT HISTORY (21 YEARS PROFESSIONAL EXPERIENCE)**

- Technician, SBW Consulting, Inc., 1990-Present
- Self-employed Builder, 1989-1990 and 1973-1983
- Research Assistant, BR Associates, NW, 1984-1988

### **SELECTED PROJECT EXPERIENCE**

**Impact and Process Evaluation of the Water Smart Technology Water Conservation Program.** For Seattle Public Utilities, Mr. Birk supported the impact evaluation of the 2001 Water Smart Technology (WST) program, one of the largest programs in the Pacific Northwest. He assisted with the development of data collection procedures for sampled sites. He performed the field data collection for the sampled sites by taking short-term measurements of cumulative water use, equipment run time and event counts, and other performance parameters for a wide variety of technologies, such as cooling towers, commercial washing machines, ice makers, irrigation controls and flush valve toilets. He assisted with the analysis of the resulting data sets to calculate ex post water savings.

**Evaluation, Measurement, and Verification of CUWCC Pre-Rinse Spray Head Distribution Program.** SBW evaluated a third party statewide energy and water conservation program for the California Urban Water Conservation Council. The program was funded by the CPUC to install more than 40,000 high-efficiency dishwashing pre-rinse spray heads at food service establishments throughout the IOU service areas in California. The evaluation included detailed metering of the water and energy performance of pre-rinse spray heads in 49 sites. Mr. Birk was responsible for the installation of metering equipment at the sites as well as the measurement of flow rates and temperatures to support the calculation of water and energy savings.

**Single Family Water Fixture Energy-related Measurements.** SBW was retained by Seattle Public Utilities and Seattle City Light to investigate the energy-related flows of water fixtures in a representative sample of single-family residences in the City of Seattle. Mr. Birk assisted in the development of data collection procedures and performed all data collection for this project. Mr. Birk took a variety of water and energy performance measurements of showerheads, faucet aerators and toilets in 71 single-family homes. Mr. Birk also acquired other useful data on characteristics of water appliances in the sampled homes. In addition Mr. Birk assisted in the analysis of the resulting data to determine current baseline conditions in Seattle and the site-level water and energy impacts of more efficient water fixtures.

**Urinal Baseline Study.** SBW recently completed a study for the Seattle Saving Water Partnership that examined the baseline performance characteristics of the existing urinal stock and assessed the practicality and cost-effectiveness of alternative strategies to significantly reduce water consumption and maintain flush effectiveness. Mr. Birk assisted with the development of data collection procedures for the determination of flush volume and flush effectiveness. He also assisted in the development of sophisticated field data collection procedures for assessing the water savings effectiveness of several alternative retrofits for reducing water consumption. He performed most of the field data collection for the project and assisted with the analysis of flush volume, flush effectiveness and measure performance data. He also conducted interviews with commercial customers on maintenance practices and urinal performance history.



**Assessment of Water and Energy Savings for Efficient Showerheads and Faucet Aerators.** SBW collected and analyzed data on the impact of efficient shower heads and faucet aerators on a sample of 80 single family residences and more than 90 multifamily units in the Pacific Northwest. Mr. Birk performed all pre-retrofit and post-retrofit data collection for this project, including a variety of one-time measurements of water temperatures and flow rates, along with continuous monitoring of flow volumes and energy use during the pre and post periods. Mr. Birk assisted with the analysis of the data that included estimates of energy and water savings for each conservation measure installed in the participating dwellings.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

***Experience evaluating programs in California*** – Mr. Birk has been deeply involved in the data collection and analysis of many impact evaluations in California over the last 15 years – both water and energy. Examples of these programs include the Pre-rinse Spray head Installation program (2002/03 and 2004/05), the 2004/05 Building Tune-up program, the 2004/05 UC/CSU/IOU energy efficiency partnership program, the 2002/03 Oakland Energy Partnership program and the 1995 and 1996 PG&E Industrial Impact evaluations. He is currently involved in the 2006/08 evaluation of the Major Commercial contract group for the CPUC.

***Collection and analysis of metering data*** - Mr. Birk is a specialist in the collection and analysis of metering data. Having been involved in the data collection aspects of almost every impact evaluation performed by SBW, he has become very experienced in the application of a variety of analysis techniques used to summarize, adjust and extrapolate the measured data for the purposes of estimating savings. He is very proficient with the Excel spreadsheet tool and is capable of producing basic statistical summaries of the data and observing trends and anomalies in energy system performance. He works efficiently and effectively under the direction of more senior engineers to assist them in performing more detailed analysis of data sets.

***Energy test instruments and procedures*** - Mr. Birk manages and maintains the metering equipment inventory at SBW. The inventory includes a wide range of equipment for the performance measurement of both water and energy technologies. On the energy side the inventory ranges from simple motor and lighting loggers to more sophisticated data logging equipment that is capable of long-term measurements of true power and other important energy system performance parameters. On the water side the inventory ranges from in-line water meters and electronic event counters to stop watches and graduated buckets for measuring flow rates. Mr. Birk is very experienced at specifying the most appropriate metering equipment for the application and budget and developing site-specific and equipment-specific procedures for the proper installation of the metering equipment. He has a very practical and thorough understanding of electronics and their application to meet the measurement objectives. In cases where available instrumentation did not fit our specific requirements, Mr. Birk has modified equipment or created customized metering systems that specifically and cost-effectively met the measurement objectives of the study. Mr. Birk also tracks the latest developments in metering equipment so that SBW can provide its clients the benefits of the latest advances.

A very important part of his inventory management duties is to calibrate the metering equipment prior to being placed in the field and to perform necessary repairs after being returned from the field. Mr. Birk is also very knowledgeable in the extraction of data from the loggers after being returned from the field and application of internal data quality control procedures to ensure the SBW analyst that the collected data can be trusted.

## WENDY ROMNEY

### ADMINISTRATIVE SUPPORT STAFF, SBW CONSULTING, INC.

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#### EDUCATION

- High School Diploma, Churchill High School, Eugene, Oregon, 1976

#### EMPLOYMENT HISTORY (16 YEARS PROFESSIONAL EXPERIENCE)

- Administrative Support Staff, SBW Consulting, Inc., 1992-Present

#### SELECTED PROJECT EXPERIENCE

**Direct Installation Program: Efficient Pre-Rinse Spray Valves.** Ms. Romney provides a wide range of administrative support, such as data entry, quality control reviews, travel planning, expense reporting, and subcontractor supervision for SBW's programs that install efficient pre-rinse spray valves. These programs have installed more than 12,000 efficient valves in three states.

**Direct Installation Program: Vending Misers.** Ms. Romney provides a wide-range of administrative support, such as data entry, quality control reviews, travel planning, expense reporting, and subcontractor supervision for SBW's programs that install Vending Misers. These programs have installed more than 11,000 Vending Misers in two states.

**Other SBW Projects.** Ms. Romney provides a wide-range of administrative support, such as data entry, travel planning, and expense reporting for many of SBW's evaluation research and other types of projects.

#### RELEVANT EXPERTISE AND QUALIFICATIONS

##### *Experience evaluating programs in California*

Ms. Romney has provided over the last 16 years a wide range of administrative support, such as data entry, quality control reviews, travel planning, expense reporting, and subcontractor supervision for all of SBW's evaluation projects in California.



## WYNETTE MILLER

### Administrative Support Staff, SBW Consulting, Inc.

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#### EDUCATION

- B.S. Degree-Business Education, Texas A&M-Commerce (Formerly East Texas State University), Commerce, TX, 1978

#### EMPLOYMENT HISTORY (5 YEARS PROFESSIONAL EXPERIENCE)

- Administrative Support Staff, SBW Consulting, Inc., 2006-Present

#### SELECTED PROJECT EXPERIENCE

**Direct Installation Program: Efficient Pre-Rinse Spray Valves.** Ms. Miller provides a wide range of administrative support, such as data entry, quality control reviews, travel planning, expense reporting, and subcontractor supervision for SBW's programs that install efficient pre-rinse spray valves. These programs have installed more than 12,000 efficient valves in three states.

**Direct Installation Program: Vending Misers.** Ms. Miller provides a wide range of administrative support, such as data entry, quality control reviews, travel planning, expense reporting, and subcontractor supervision for SBW's programs that install Vending Misers. These programs have installed more than 11,000 Vending Misers in two states.

**Other SBW Projects.** Ms. Miller provides a wide range of administrative support, such as data entry, travel planning, and expense reporting for many of SBW's evaluation research and other types of projects.

#### RELEVANT EXPERTISE AND QUALIFICATIONS

##### *Experience evaluating programs in California*

Ms. Miller has provided over the last 2 years a wide range of administrative support, such as data entry, quality control reviews, travel planning, expense reporting, and subcontractor supervision for a number of SBW's projects in California.

## PETER GLEICK

### President, Pacific Institute

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#### EDUCATION

- Ph.D., Energy and Resources, University of California at Berkeley (1986)
- M.S., Energy and Resources, University of California at Berkeley (1980)
- B.S., Engineering and Applied Science, Yale University (1978)

#### EMPLOYMENT HISTORY (21 YEARS PROFESSIONAL EXPERIENCE)

- President and Co-Founder, Pacific Institute, 1987-Present

#### SELECTED PROJECT EXPERIENCE

**Hidden Oasis: Water Conservation and Efficiency in Las Vegas.** Dr. Gleick was co-author on a report that evaluated water conservation and efficiency efforts in the Las Vegas Valley. The report included an analysis of existing conservation efforts, including rate structures, rebates, regulations, and educational programs, in seven Western cities. An end-use analysis was applied to a subset of customers (single-family residential, casinos, and resorts) to quantify the untapped conservation and efficiency potential. The analysis concluded that existing conservation measures could reduce demand in these sectors by nearly 40%, equivalent to an annual savings of 86 thousand acre-feet.

**Evaluation of Water Efficiency Potential in Atlanta, Georgia.** The Pacific Institute evaluated the potential for water-use efficiency improvements and programs in Atlanta, as part of an effort to review inter-state water agreements.

**California Water 2030: An Efficient Future.** Dr. Gleick was co-author on a report that details how smart technology, strong management, and appropriate rates and incentives can allow the state to meet its needs well into the future with less water. The analysis, which provides a sharp contrast to the California Department of Water Resources 2005 Draft California Water Plan, found that water demand in the year 2030 could be 20% below current levels by adopting widely available, cost-effective conservation technologies and policies. The report concludes with a set of recommendations to promote greater adoption of water conservation and efficiency measures.

**Waste Not, Want Not: The Potential for Urban Water Conservation in California.** Dr. Gleick was co-author on a comprehensive statewide end-use analysis that evaluated the water conservation and efficiency potential of California's urban sector. The study concluded that Californians could reduce current (year 2000) urban water demand by more than 30 percent with widely available, existing technologies and policies.

#### RELEVANT EXPERTISE AND QUALIFICATIONS

##### *Experience evaluating programs in California*

For over twenty years Gleick has directed and participated in a wide range of program evaluations in California in the areas of water management, water conservation and efficiency, and water and energy.

***Experience working with local water agencies, especially evaluating water conservation programs***

A series of research projects at the Pacific Institute works directly with local water agencies, evaluating conservation and efficiency programs. This work involves assessments of implementation rates, technology choices, economic and pricing strategies, and barriers to efficiency improvements.

***Experience with water systems analysis including physical and engineering principles***

Gleick's training and experience includes engineering of water systems, environmental effects of large and small hydroelectric systems, and the water implications of renewable and non-renewable energy technologies.

***Overall experience in the water field in California***

Gleick is one of the state's leading experts on overall California and western water policy and science. He has over 25 years of experience in working with state agencies, non-governmental organizations, and academic communities evaluating water supply, demand, management, and impacts of human use, including climate change, excessive withdrawals, and complex policy development. Among his credentials, Gleick has served on:

- National Academy of Sciences Committee on Ecological Impacts of Climate Change, 2008-2009
- Climate Advisory Group of the California Academy of Sciences, 2007-
- State of California Climate Change Technical Advisory Group, 2007-
- National Academy of Sciences Committee on Advancing Desalination Technology, 2006-2008
- Vice Chair, American Geophysical Union Global Environmental Change Focus Group, 2006-2008
- Water Science and Technology Board, National Academy of Sciences, 2001-2007.
- Advisory Committee: Rethinking Water Policy Opportunities in California, UCSB/Rand Research, 2005-2006.
- Public Advisory Committee: California Water Plan 2003. Department of Water Resources, 2001-2006.
- Editorial Board: Senior Advisory Council. Environmental Research Letters, 2006-2008.
- Editorial Board, Annual Reviews of Energy and the Environment, 2001-2004
- Editorial Board, Climatic Change, 1990-present.
- Editorial Board, Water Policy, 1997-present
- Advisory Council, International Water Academy, Oslo, Norway, 2003-2005.
- Board of Directors: International Water Resources Association, 1997-2000.
- Global Environmental Change Committee, American Geophysical Union, 1993-1998.
- Public Advisory Forum: American Water Works Association, 1993-1998.

***Experience evaluating embedded energy, especially offsite effects of cold water savings***

Gleick and the Pacific Institute have done some of the earliest work on the energy implications of water conservation and efficiency technologies. This includes work to calculate energy embedded in water pumping, transportation, purification, treatment, distribution, and end-use. Gleick has testified on these issues before Congress and participated in the initial rounds of the U.S. DOE Energy Water Roadmap effort.

***Collection and analysis of metering data***

Gleick is working with Aquacraft, Inc. to analyze a large set of metered data to assess the potential for additional efficiency improvements throughout California, as part of an ongoing California Energy Commission research effort.

## HEATHER COOLEY

### Senior Research Associate, Pacific Institute

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#### EDUCATION

- M.S., Energy and Resources, University of California at Berkeley (2004)
- B.S., Molecular Environmental Biology, University of California at Berkeley (1998)

#### EMPLOYMENT HISTORY (12 YEARS PROFESSIONAL EXPERIENCE)

- Senior Research Associate, Pacific Institute, 2004-Present
- Research Associate/Laboratory Manager, Lawrence Berkeley National Laboratories, 2000-2004
- Field/Laboratory Technician, University of California at Berkeley, 1996-2000

#### SELECTED PROJECT EXPERIENCE

**Hidden Oasis: Water Conservation and Efficiency in Las Vegas.** Ms. Cooley was the leader author on a report that evaluated water conservation and efficiency efforts in the Las Vegas Valley. The report included an analysis of existing conservation efforts, including rate structures, rebates, regulations, and educational programs, in seven Western cities. An end-use analysis was applied to a subset of customers (single-family residential, casinos, and resorts) to quantify the untapped conservation and efficiency potential. The analysis concluded that existing conservation measures could reduce demand in these sectors by nearly 40%, equivalent to an annual savings of 86 thousand acre-feet.

**A Review of the SFPUC's Retail and Wholesale Customer Water Demand Projections.** In an effort to satisfy the future water needs of its wholesale customers, the San Francisco Public Utilities Commission (SFPUC) commissioned a series of comprehensive assessments on the area's future water demand, conservation potential, and recycled water potential. Based on these studies, the SFPUC projects that total water demand of its wholesale and retail customers will increase by 14%, or 33 million gallons per day, by 2030.

Ms. Cooley assumed the lead on an independent review of the SFPUC wholesale and retail customer demand projections and the companion reports on water conservation and recycled water. This analysis found that the commercial and industrial users were responsible for nearly 80% of future increases in demand. In addition, nearly 60% of the increased demand was due to outdoor use. Based on these findings, the analysis concluded that the SFPUC's demand and conservation studies fail to adequately estimate future water demand and fall short of proven efficiency levels. The report offers recommendations to assist the SFPUC in improving their modeling, assessment, and conservation efforts.

**Evaluation of Water Efficiency Potential in Atlanta, Georgia.** The Pacific Institute evaluated the potential for water-use efficiency improvements and programs in Atlanta, as part of an effort to review inter-state water agreements.

**California Water 2030: An Efficient Future.** Ms. Cooley was co-author on a report that details how smart technology, strong management, and appropriate rates and incentives can allow the state to meet its needs well into the future with less water. The analysis, which provides a sharp contrast to the California Department of Water Resources 2005 Draft California Water Plan, found that water demand in the year 2030 could be 20% below current levels by adopting widely available, cost-effective conservation technologies and policies. The report concludes with a set of recommendations to promote greater adoption of water conservation and efficiency measures.

## RELEVANT EXPERTISE AND QUALIFICATIONS

### *Experience working with local water agencies, especially evaluating water conservation programs*

Ms. Cooley has worked with local water agencies on a variety of projects. She worked with the San Francisco Public Utilities Commission (SFPUC) and the Bay Area Water Supply and Conservation Agency on an analysis of the SFPUC's retail and wholesale customer demand projections. She has also worked with the City of Santa Rosa to evaluate their existing conservation programs and provide input on new programs. Ms. Cooley is now developing a model that will help agencies determine if a conservation measure or set of measures is cost-effective. A number of water agencies throughout California are now serving as advisors for this project.

### *Overall experience in the water field in California*

Ms. Cooley has worked on a variety of water issues in California, including water conservation and efficiency, seawater desalination, climate change, and the water-energy nexus. She has authored a series of reports on these topics and has given dozens of presentations on California water issues.

### *Experience evaluating embedded energy, especially offsite effects of cold water savings*

Using the Pacific Institute's Water-to-Air model, Ms. Cooley evaluated the energy implications of various water supply and demand management options for meeting California's projected water use in the year 2030. The Water-to-Air model is a generalized, transparent spreadsheet model that allows users to compare the air and energy implications of various water management scenarios. The analysis included the energy use associated with capturing, conveying, treating (both water and wastewater), distributing, and using water in California.

Ms. Cooley evaluated the energy use associated with manufacturing bottled water, including the embedded energy in the water itself. Energy is required to capture and convey water to the bottling plant. Bottled water comes from municipal water sources, as well as self-supplied surface and groundwater systems, with each source having considerably different energy intensities. Upon reaching the bottling plant, the water undergoes further treatment. This analysis estimated the energy requirements for each source and subsequent treatment at the bottling plant. These results were then compared to the energy requirements associated with the plastic bottle and its production.

## MATTHEW HEBERGER, P.E.

### Research Associate, Pacific Institute

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#### EDUCATION

- M.S., Civil and Environmental Engineering, Tufts University (2003)
- B.S., Agricultural and Biological Engineering, Cornell University (1996)

#### EMPLOYMENT HISTORY (12 YEARS PROFESSIONAL EXPERIENCE)

- Research Associate, Pacific Institute, 2007-Present
- Engineer, CDM, 2003-2007
- Research Assistant, Tufts University, 2001–2003
- Coordinator, International Network on Participatory Irrigation Management, 1999–2001
- Water and Sanitation Extension Agent, US Peace Corps, 1996–1998

#### SELECTED PROJECT EXPERIENCE

**Hidden Oasis: Water Conservation and Efficiency in Las Vegas.** Mr. Heberger was co-author on a report that evaluated water conservation and efficiency efforts in the Las Vegas Valley. The report included an analysis of existing conservation efforts, including rate structures, rebates, regulations, and educational programs, in seven Western cities. An end-use analysis was applied to a subset of customers (single-family residential, casinos, and resorts) to quantify the untapped conservation and efficiency potential. The analysis concluded that existing conservation measures could reduce demand in these sectors by nearly 40%, equivalent to an annual savings of 86 thousand acre-feet.

**Evaluation of Water Efficiency Potential in Atlanta, Georgia.** The Pacific Institute evaluated the potential for water-use efficiency improvements and programs in Atlanta, as part of an effort to review inter-state water agreements.

#### RELEVANT EXPERTISE AND QUALIFICATIONS

##### *Statistical analysis, specifically regression modeling and sampling*

Mr. Heberger had formal training in advanced statistical methods in graduate school. As a part of his MS thesis, Mr. Heberger built ordinary least squares and logistic regression models to predict water quality in urban rivers.

##### *Experience with water monitoring and control equipment*

From 2001–2003, Mr. Heberger installed and maintained five continuous water quality monitoring stations, including related hardware, software, and radio telemetry equipment, for the project *Real-Time Water Quality Monitoring and Modeling on the Mystic River*. He performed weekly field checks and monthly calibrations of equipment, reviewed incoming data and performed Quality Assurance/Quality Control necessary for final data publication, and created protocols and computer programs for water quality data management, visualization, and post-processing.

##### *Experience with water systems analysis including physical and engineering principles*

**U.S. Army Corps of Engineers, Merrimack River Watershed Assessment Study, Massachusetts and New Hampshire.** Assisted in a comprehensive modeling program for an 80-mile reach of the Merrimack River. The purpose of the study is to quantify the sources and effects of primary pollutants and to evaluate

the impacts of various watershed-wide restoration strategies for maximizing the attainment of beneficial uses, including water supply, aquatic habitat, recreation, and hydropower. Created a complex hydrologic and water quality model for the 5,000 square mile Merrimack watershed in HSPF. Made extensive use of ArcView and ArcMap GIS software to assemble model input data. Compiled and analyzed large climate data sets from hundreds of gages in four states.

**New Jersey Turnpike Authority, Environmental Impact Statement, Route 92 \* Middlesex County, NJ.** Provided GIS support for stormwater studies that were part of the planning process for a proposed 6.7-mile, 4-lane limited access highway. Used GIS to integrate disparate data sources, map scale formats, and aerial photography. Developed graphic displays for the stormwater management study.

**New Jersey Turnpike Authority Proposed Route 92 Stormwater Management Plan.** Performed planning-level hydrologic analyses using NetSTORM, and the New Jersey Groundwater Recharge Spreadsheet. Prepared numerous report-quality maps. Imported existing road design in AutoCAD and MicroStation format to ArcGIS to develop a consistent geographic dataset for performing analyses.

### ***Overall experience in the water field in California***

Currently working on several studies of water in California: The Costs of Adapting to Sea Level Rise, Decision Support Tool for Conservation and Efficiency Programs and Rebates, and Agricultural Water-Use Efficiency: Science and Policy Analysis.

### ***Hydraulic engineering and analysis experience***

Mr. Heberger is a licensed Environmental Engineer in the Commonwealth of Massachusetts, with a specialization in water resources engineering, hydrology, and hydraulics. He has performed a range of hydraulic analyses, including the following.

**FEMA Region I, Blackstone River Watershed Study, Worcester County, Massachusetts, and Providence County, Rhode Island.** Conducted hydrologic studies in support of a National Flood Insurance Program floodplain mapping effort. Performed statistical analyses using U.S. Geological Survey discharge data to determine 10-, 50-, 100- and 500-year flood events. Performed field reconnaissance of the river channel, bridges, dams, and culverts to estimate roughness coefficients (Manning's  $n$ ) for use in hydraulic modeling and floodplain analysis. Prepared technical memorandum detailing study results.

**Hartford, Connecticut Combined Sewer Abatement Program.** Developed or modified a series of models of the sub-surface drainage network in Hartford in EPA's Stormwater Management Model (SWMM) using design drawings, as-builts, and field reconnaissance data. Performed modeling to analyze conceptual designs and test scenarios.



## LISA WASSERMAN

### Senior Project Manager, Population Research Systems

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#### EDUCATION

- M.S., Psychology, San Francisco State University, (1995)  
Emphasis in Marriage, Family and Child Counseling, Rehabilitation Counseling
- B.A., Psychology and Communication Studies, University of Massachusetts at Amherst (1990)

#### EMPLOYMENT HISTORY (12 YEARS PROFESSIONAL EXPERIENCE)

- Senior Research Project Manager, Population Research Systems, 2001-Present
- Research Technician/Counselor, UCSF/SF VA, 1997-2001
- Program Coordinator, San Francisco State University, 1996-1999

#### SELECTED PROJECT EXPERIENCE

**PG&E, 2004-05 Local Government Partnerships Program Evaluation.** This evaluation was designed to provide a comprehensive evaluation of seven Local Government Partnership programs—a new program delivery structure PG&E is offering in conjunction with local governments (usually cities and/or counties). The research was conducted to provide feedback to enhance future program implementation and to verify energy-efficiency savings. Key components included an analysis of program structure, logic, and implementation; over fifty stakeholder interviews, 2400 participant telephone surveys with 300 nested onsite verification inspections; evaluation of marketing materials, and analysis of program data.

**Lawn and Garden Study.** Funded by NREB and conducted for Sonoma Technology, Inc., this study examined summertime use of lawn and garden equipment within Los Angeles. We interviewed 151 managers and supervisors within lawn and garden companies servicing both residential and commercial properties such as schools, golf courses, and park and recreation areas. The purpose of the 2001 study was to gather detailed information about lawn and garden business activities to better understand weekday versus weekend air emissions within the Los Angeles basin.

**Los Angeles Spare the Air Household and Business Air Emissions Project.** Working with Sonoma Technology, Inc. the primary intent of this study was to identify and enumerate activities that could potentially create ozone-affecting atmospheric emissions within four well-defined zones in the Los Angeles, California area, to collect data that would facilitate a comparison between daily variations in such activities and atmospheric ozone levels. Utilizing interviews and survey postcards, 581 interviews were completed generating a 51% response rate.

**Pleasure Craft Usage and Emissions Study.** As part of the project team in this project for the California Air Resources Board, we provided services to Systems Applications International (SAI) for the completion of all data collection (4,400 boat owners) and analysis of pleasure craft usage patterns in California. SAI developed a model to estimate emissions from pleasure craft for each of the 58 California counties. Data were collected via mail sent bi-weekly to a geographically stratified random sample of boat owners. The sample was distributed over a one-year period divided into three seasons of activity. We designed the sample, the strategic approach and the study questionnaire.

**Midwest Energy Efficiency Alliance (MEEA) Residential Energy Survey.** In collaboration with SERA, Inc, we conducted a residential energy study for the Midwest Energy Efficiency Alliance in the five active states of the Alliance. The telephone survey gathered information on heating and cooling systems and energy-using equipment present in residential households in these states. The 491 collected



surveys were assessed in order to help facilitate the Alliance in better planning for the future energy needs of residential customers in the Midwest.

## RELEVANT EXPERTISE AND QUALIFICATIONS

### *Development of survey instruments and interviewing*

**Targeted Customer Appliance Program, Impact and Process Evaluation.** For Pacific Gas and Electric Company and in cooperation with Cambridge Systematics, Inc., we carried out this mixed-mode survey of customers who had participated in PG&E's TCAP program. The survey was carried out in two stages. In the first stage, a total of 1,060 randomly selected participants were surveyed by telephone. Information about appliance persistence, household demography and energy use behavior was collected. In the second stage, on-site interviews were conducted with a randomly selected group of 200 households. The on-site interviews were conducted in English, Cantonese and Mandarin to verify and up-date estimates of first year energy savings of electric and gas appliances; capacity or peak demand electric power savings; net-to-gross ratio of energy savings and accounting rates of free riders; un-installed appliances and removed appliances; and recommendations to improve the program's design.

**Household and Commercial Study for the Transportation Fuel Demand Forecast.** California Energy Commission, Sacramento, CA; Kema, Oakland, CA. This project involved a mixed mode survey design of households and commercial fleet vehicle operators to assess current vehicle ownership, the factors inherent to purchasing a new vehicle, the likelihood of purchasing an alternative fuel vehicle or other advanced technology vehicle, and firmographic/demographic information. The survey was conducted in two stages. The first stage involved 4,110 randomly selected household participants, and 1,885 randomly selected commercial participants who were surveyed by telephone. Data was collected on current vehicle ownership by number, class and model year of vehicles, purchase and disposal behavior in regard to vehicles and behaviors related to vehicle usage. Goal of the data collection was the assessment of the current vehicle fleet in the State and the projection of future fleet composition and respective fuel needs. Information from the first stage was used to determine eligibility for the second stage of the project. A total of 2,331 households and 1,128 businesses were identified as ineligible and were invited to participate in stage two.

Stage two of the project consisted of a tailored preference choice experimental task that elicited the trade-offs respondents were willing to make among characteristics of alternatives offered to them. Respondents were mailed an invitation letter, a dollar coin as a pre-incentive, and a personalized choice exercise survey that contained the collected key variables from the phone interview in stage one. The survey was completed either by phone, mail, or web/internet, based on preference and respondents received a \$20 (\$25 for businesses) incentive. Overall 1,589 households and 731 businesses completed the follow-up stage two survey for a response rate of 68% and 65% respectively.

**Estimating the Demand for Alternative-Fueled Vehicles.** *Toyota and General Motors, Troy, MI.* The goal of this study was to estimate the demand for alternative-fueled vehicles in California and the extent to which this demand was affected by the provision of detailed information about alternative-fueled vehicles and air quality issues. We collaborated with Toyota and General Motors on the design and construction of the recruitment screener and data collection instrument. Using the CATI lab, 1,439 Californians were recruited to participate in the study and were mailed a unique set of 15 different vehicle choices with forced choices between three different subsets printed on a "choice exercise" sheet. Half of the participants were also mailed an information kit about the alternative-fueled vehicle and about air quality issues. After receiving their unique package, the participants were interviewed via telephone to review their vehicle choices. The final data set consisted of 1,037 completed interviews.

**Emissions Inventory of Agricultural Internal Combustion Engines.** Commissioned by the San Joaquin Valley Unified Air Pollution Control District and working with Sonoma Technology, Inc. (STI), we designed both the sample and questionnaire to assess the type and use of irrigation pumps by county

and crop type. Three hundred telephone interviews were conducted through our CATI laboratory with a representative sample of San Joaquin Valley farmers. STI engineers incorporated these data in an emissions model to estimate atmospheric pollutant output by fueled engine irrigation pumps.

**Pacific Gas and Electric Company, 2005 Value of Service Reliability Study.** The purpose of this large-scale research was to collect primary data regarding customer outage costs for four distinct customer sectors—residential, small commercial/industrial, agricultural, and large commercial/industrial. The research was conducted using mixed modalities ranging from mail (residential sector), telephone recruit followed by a mailed survey instrument (small nonresidential and agricultural sectors), and executive in-person interviews (large commercial/industrial sector). More than 2,400 customers were surveyed for this study.

**Off-Road Equipment Activity Data Study.** Along with Systems Application International, Inc. (SAI), we developed two studies for this project. The first sub-study was designed to obtain activity data for off-road combustion engine equipment used by households. The second sub-study was designed to obtain similar data from the construction industry. Both were statewide mail surveys with the construction survey stratified by company size. We implemented the survey and analyzed the results based on 116 residential respondents and 313 construction companies. Findings for over fifty different equipment categories were used by SAI engineers to update the California off-road equipment inventory emissions model.

### ***Overall experience in the water field in California***

**Value of Water Quality Study.** *Metropolitan Water District of Southern California, Glendale, CA.* We were hired by MWD to estimate the economic worth of lowering the salinity of the water provided by the water utility serving most of Southern California outside the city of Los Angeles. The economic worth of lowered salinity was being measured for both residential and commercial/industrial customers. Two separate surveys were performed in this study. One survey was a mail survey of residential customers designed to measure household consumption of bottled water and use of water purification and desalination equipment. Econometric models incorporating information about salinity of the water experienced by each household and other demographic and preference characteristics were used to estimate the economic value of lowered salinity. The commercial survey was a telephone survey designed to measure the market penetration of water purification and desalination equipment. Approximately 5,000 survey observations were collected over the course of this study. The information was used by the District to quantify the benefits associated with investments designed to lower the salinity of water provided to its customers.

**Park Water Company Customer Survey.** The project goal of the Park Water Company Customer Survey was to better understand customers' needs and preferences in the Los Angeles County portion of Park Water's service territory and to facilitate Park Water Company's customized communication with its customers. Themes explored include information needs, language preference, payment method preference as well as perception of the company. Three hundred and eighty seven interviews were completed in English and Spanish. We collaborated with Park Water Company in creating the telephone interview, analyzing data, and developing reports and presentations for its Board.

## JENNIFER IBARDOLAZA

### Study Coordinator, Population Research Systems

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#### EDUCATION

- M.A., Community and Developmental Psychology, New York University (2007)
- B.A., Psychology, San Francisco State University (2003)

#### EMPLOYMENT HISTORY (2 YEARS PROFESSIONAL EXPERIENCE)

- Study Coordinator, Population Research Systems,, 2006-Present

#### SELECTED PROJECT EXPERIENCE

**Park Water Company Customer Survey.** The project goal of the Park Water Company Customer Survey was to better understand customers' needs and preferences in the Los Angeles County portion of Park Water's service territory and to facilitate Park Water Company's customized communication with its customers. Themes explored included information needs, language preference, payment method preference as well as perception of the company. Three hundred and eighty seven interviews were completed in English and Spanish. We collaborated with Park Water Company in creating the telephone interview, analyzing data, and developing reports and presentations for its Board.

**NYSERDA Program Evaluation.** This comprehensive study was a joint effort between us, Summit Blue Consulting and SERA, Inc. The project, consisting of multiple telephone survey segments, was to identify ways to promote energy efficiency measures as well as overcome barriers to using these measures in New York. The first two parts of the study involved Energy Consultants and Technical Service Providers that did not participate in NYSERDA programs. These sections were aimed at identifying prominent characteristics in the energy efficient equipment market and assessing their awareness and perception of all the sub-programs of the New York Energy Smart Program. The third part of the study involved actual customers that had their building's heating and cooling systems serviced by a NYSERDA-participating contractor that used advanced diagnostic tools to check system performance. This section focused on end-use customers' perception on energy efficiency measures and their value. The fourth part of the study researched HVAC contractors that participated in the NYSERDA Unitary HVAC Program. This section assessed the contractors' understanding and interest in Demand Control Ventilation and market conditions for these systems. The study's fifth and sixth parts researched Lighting Products Distributors that have participated in NYSERDA programs. Active distributors were asked about specific details and accomplishments of a lighting project they worked on in collaboration with NYSERDA. Inactive distributors were asked about the biggest barriers they encountered as well as about ways to make participating in the program friendlier.

**Midwest Energy Efficiency Alliance (MEEA) Residential Energy Survey.** We conducted a residential energy study for the Midwest Energy Efficiency Alliance in collaboration with SERA, Inc. in the five active states of the Alliance. The telephone survey gathered information on heating and cooling systems and energy-using equipment present in residential households in these states. The 491 collected surveys were assessed in order to help facilitate the Alliance in better planning for the future energy needs of residential customers in the Midwest.

**Estimating the Demand for Alternative-Fueled Vehicles.** The goal of this study was to estimate the demand for alternative-fueled vehicles in California and the extent to which this demand was affected by the provision of detailed information about alternative-fueled vehicles and air quality issues. We collaborated with Toyota and General Motors on the design and construction of the recruitment screener

and data collection instrument. Using the CATI lab, 1,439 Californians were recruited to participate in the study and were mailed a unique set of 15 different vehicle choices with forced choices between three different subsets printed on a “choice exercise” sheet. Half of the participants were also mailed an information kit about the alternative-fueled vehicle and about air quality issues. After receiving their unique package, the participants were interviewed via telephone to review their vehicle choices. The final data set consisted of 1,037 completed interviews.

## RELEVANT EXPERTISE AND QUALIFICATIONS

### *Development of survey instruments and interviewing*

**NJ ENERGY STAR® Products Program Consumer Telephone Survey.** *Quantec, LLC, Colorado and New Jersey Board of Public Utilities, New Jersey.* In cooperation with Quantec, LLC in Boulder, Colorado, PRS completed an end-user telephone survey on behalf of the New Jersey Board of Public Utilities. The study was aimed at understanding and evaluating the Energy Star marketing program and products. The information collected will be used to help state officials make decisions about future energy-efficiency programs for consumers. Through random digit dialing, PRS contacted New Jersey residents and interviewed those who had purchased a refrigerator, clothes washer, room air conditioner, lighting fixture, light bulb, thermostat, window or central heating/cooling system in the two years prior to the interview. The main topic explored was the respondents’ awareness and attitude toward Energy Star. Respondents were asked about their purchase decisions and likelihood to purchase Energy Star products in the future.

**MICRO Residential and Business Study.** *Sonoma Technology, Inc., Petaluma, CA.* For the MICRO study, which was sponsored by the California Air Resources Board (ARB), residents and businesses within a 5 km radius of air monitoring equipment in the South Coast Air Basin (Los Angeles, Orange, Riverside, and San Bernardino counties) were surveyed regarding air quality related activities on weekdays and weekends. The residential study surveyed 471 households by telephone and recruited them to fill out daily activity postcards over a 10-day period. For the business study, 137 telephone interviews were conducted.

**Woodburning Study.** *E.H. Pechan & Associates, Inc., Shingle Springs, CA.* We completed 1,905 residential interviews concerning annual consumption of real wood and artificial logs within 11 states (Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Connecticut) and the District of Columbia to fill 24 quota cells based on census tracts characteristics: land use/cover, latitude, and dwelling type. Four hundred fourteen households (21.7%) burned wood; 198 households (10.4%) had wood burning equipment, but did not burn any wood; and 1,293 households (67.9%) did not own any wood burning equipment.

**Off-Road Equipment Activity Data Study.** Along with Systems Application International, Inc. (SAI), we developed two studies for this project. The first sub-study was designed to obtain activity data for off-road combustion engine equipment used by households. The second sub-study was designed to obtain similar data from the construction industry. Both were statewide mail surveys with the construction survey stratified by company size. We implemented the survey and analyzed the results based on 116 residential respondents and 313 construction companies. Findings for over fifty different equipment categories were used by SAI engineers to update the California off-road equipment inventory emissions model.

### *Experience evaluating programs in California*

**Evaluation of the California Tobacco Control Program.** University of Southern California, Institute for Health Promotion and Disease Prevention Research, Los Angeles, CA and the Gallup Organization. The school-based component of the Independent Evaluation of California's Tobacco Control Program was a panel study conducted by the Gallup Organization and the Institute for Health Promotion and Disease

Prevention Research at the University of Southern California (USC). The objective of this component was the evaluation of the effectiveness of tobacco control programs offered in California schools. PRS was responsible for Wave 2 data collection in the northern California counties. PRS completed Wave 3 data collection in eighteen selected counties of California. The survey was administered to students in randomly selected 5th, 8th, 10th and 12th grade classrooms, including all students in the selected class. PRS organized and managed the complete data collection process and administered a total of 1,076 classroom surveys in the final wave.

**Project Smart Money.** *Department of Health Services, Sacramento, CA.* PRS was awarded a three year project by the Tobacco Control Section (TCS) of the Department of Health Services (DHS) that commenced in January 2006. PRS field interviewing staff were trained in a rigorous protocol that had previously been instituted by TCS for the Project Smart Money project. The project entails conducting observations at rodeo, motorsport, teamroping, bull riding, and selected arts and community events throughout the state of California and PRS' role is the dispatch of field observers to events with a possibility of tobacco sponsorship. The field staff conducts initial research on the event, and selects a time to attend when there is the highest prevalence of "youth" oriented activities. The evaluation includes a detailed observation form and taking photographs and videos of event activities of any potential violations of the Master Settlement Agreement - in which tobacco sponsors are very limited on the degree of advertising, specifically around youth related program components. The PRS field staff uploads all observation media material to a secured server, and this information is then transferred electronically to a designated site at the DHS. All media material collected is reviewed by DHS staff as well as the Attorneys General Office of California. On average, PRS field observers attend an average of 80 events per calendar year and this project will be extended to continue through 2010.

## CANDACE FARLEY

### CATI Supervisor/Executive Interviewer, Population Research Systems

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#### EDUCATION

- A.A., Medical Terminology (1982)

#### EMPLOYMENT HISTORY (14 YEARS PROFESSIONAL EXPERIENCE)

- CATI Supervisor, Population Research Systems, San Francisco, CA, 2006-present
- CATI Interviewer, Population Research Systems, San Francisco, CA, 2005-2006
- CATI Supervisor, Field Research Corporation, San Francisco, CA, 1993-2004
- Medical Claims Adjuster, Blue Shield of CA, San Francisco, CA, 1982-1992

#### SELECTED PROJECT EXPERIENCE

**Midwest Energy Efficiency Alliance (MEEA) Residential Energy Survey.** We conducted a residential energy study for the Midwest Energy Efficiency Alliance in collaboration with SERA, Inc. in the five active states of the Alliance. The telephone survey gathered information on heating and cooling systems and energy-using equipment present in residential households in these states. The 491 collected surveys were assessed in order to help facilitate the Alliance in better planning for the future energy needs of residential customers

**Smoking Cessation Campaign Study.** University of California at Berkeley and Blue Shield of America. The University of California at Berkeley (UCB) Smoking Cessation Longitudinal Study was designed to evaluate the efficacy of smoking cessation programs for Blue Shield of California IFP/PPO members aged 18 to 64 years. PRS was responsible for recruiting subjects into the study and for completing a baseline and eight-month follow-up telephone interviews with 777 subjects in three study groups: smoking cessation drugs only, smoking cessation drugs plus optional counseling and counseling plus optional smoking cessation drugs.

**Estimating the Demand for Alternative-Fueled Vehicles.** *Toyota and General Motors, Troy, MI.* The goal of this study was to estimate the demand for alternative-fueled vehicles in California and the extent to which this demand was affected by the provision of detailed information about alternative-fueled vehicles and air quality issues. We collaborated with Toyota and General Motors on the design and construction of the recruitment screener and data collection instrument. Using the CATI lab, 1,439 Californians were recruited to participate in the study and were mailed a unique set of 15 different vehicle choices with forced choices between three different subsets printed on a “choice exercise” sheet. Half of the participants were also mailed an information kit about the alternative-fueled vehicle and about air quality issues. After receiving their unique package, the participants were interviewed via telephone to review their vehicle choices. The final data set consisted of 1,037 completed interviews.

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randomly selected 5th, 8th, 10th and 12th grade classrooms, including all students in the selected class. PRS organized and managed the complete data collection process and administered a total of 1,076 classroom surveys in the final wave.

## RELEVANT EXPERTISE AND QUALIFICATIONS

### *Development of survey instruments and interviewing*

**NJ ENERGY STAR® Products Program Consumer Telephone Survey.** *Quantec, LLC, Colorado and New Jersey Board of Public Utilities, New Jersey.* In cooperation with Quantec, LLC in Boulder, Colorado, PRS completed an end-user telephone survey on behalf of the New Jersey Board of Public Utilities. The study was aimed at understanding and evaluating the Energy Star marketing program and products. The information collected will be used to help state officials make decisions about future energy-efficiency programs for consumers. Through random digit dialing, PRS contacted New Jersey residents and interviewed those who had purchased a refrigerator, clothes washer, room air conditioner, lighting fixture, light bulb, thermostat, window or central heating/cooling system in the two years prior to the interview. The main topic explored was the respondents' awareness and attitude toward Energy Star. Respondents were asked about their purchase decisions and likelihood to purchase Energy Star products in the future.

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**Household and Commercial Study for the Transportation Fuel Demand Forecast.** California Energy Commission, Sacramento, CA; Kema, Oakland, CA. This project involved a mixed mode survey design of households and commercial fleet vehicle operators to assess current vehicle ownership, the factors inherent to purchasing a new vehicle, the likelihood of purchasing an alternative fuel vehicle or other advanced technology vehicle, and firmographic/demographic information. The survey was conducted in two stages. The first stage involved 4,110 randomly selected household participants, and 1,885 randomly selected commercial participants who were surveyed by telephone. Data was collected on current vehicle ownership by number, class and model year of vehicles, purchase and disposal behavior in regard to vehicles and behaviors related to vehicle usage. Goal of the data collection was the assessment of the current vehicle fleet in the State and the projection of future fleet composition and respective fuel needs. Information from the first stage was used to determine eligibility for the second stage of the project. A total of 2,331 households and 1,128 businesses were identified as ineligible and were invited to participate in stage two.

Stage two of the project consisted of a tailored preference choice experimental task that elicited the trade-offs respondents were willing to make among characteristics of alternatives offered to them. Respondents were mailed an invitation letter, a dollar coin as a pre-incentive, and a personalized choice exercise survey



that contained the collected key variables from the phone interview in stage one. The survey was completed either by phone, mail, or web/internet, based on preference and respondents received a \$20 (\$25 for businesses) incentive. Overall 1,589 households and 731 businesses completed the follow-up stage two survey for a response rate of 68% and 65% respectively.

## DAVID CYBULSKI

### CATI Supervisor/Executive Interviewer, Population Research Systems

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#### EDUCATION

- M.A., Social Psychology – San Francisco State University (expected 2008)
- B.A., Psychology, Maryville College (2001)

#### EMPLOYMENT HISTORY (3 YEARS PROFESSIONAL EXPERIENCE)

- CATI Supervisor, Population Research Systems, 2007-Present
- CATI Interviewer, Public Research Institute, 2006-2007
- Field Interviewer, Public Research Institute, 2005-2006

#### SELECTED PROJECT EXPERIENCE

**Midwest Energy Efficiency Alliance (MEEA) Residential Energy Survey.** We conducted a residential energy study for the Midwest Energy Efficiency Alliance in collaboration with SERA, Inc. in the five active states of the Alliance. The telephone survey gathered information on heating and cooling systems and energy-using equipment present in residential households in these states. The 491 collected surveys were assessed in order to help facilitate the Alliance in better planning for the future energy needs of residential customers in the Midwest.

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**Cancer Risk Factor Behaviors Among Vietnamese Adolescents.** *University of California, San Francisco, CA* PRS recruited and interviewed 800 Vietnamese adolescents between the ages of 12 and 15 for a panel study with follow-up interviews at 12 months. This research examined male and female adolescent behaviors with respect to known risk factors for cancer. The project was funded by the American Cancer Society.

#### RELEVANT EXPERTISE AND QUALIFICATIONS

##### *Development of survey instruments and interviewing*

**NJ ENERGY STAR® Products Program Consumer Telephone Survey.** *Quantec, LLC, Colorado and New Jersey Board of Public Utilities, New Jersey.* In cooperation with Quantec, LLC in Boulder, Colorado, PRS completed an end-user telephone survey on behalf of the New Jersey Board of Public

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selected commercial participants who were surveyed by telephone. Data was collected on current vehicle ownership by number, class and model year of vehicles, purchase and disposal behavior in regard to vehicles and behaviors related to vehicle usage. Goal of the data collection was the assessment of the current vehicle fleet in the State and the projection of future fleet composition and respective fuel needs. Information from the first stage was used to determine eligibility for the second stage of the project. A total of 2,331 households and 1,128 businesses were identified as ineligible and were invited to participate in stage two.

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## **ESKINDER BERHANU**

**Mechanical Engineer, PE, CEM, LEED, CMVP, CDSM, SDV ACCI, Inc.**

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### **EDUCATION**

- Post-Master's work, Mechanical Engineering at the University of California at Irvine
- M.S., Mechanical Engineering from Howard University, Washington DC
- B.S., Mechanical Engineering, Addis Ababa University
- HVAC Systems Design and Control at the University of California at San Diego

### **LICENSE/CERTIFICATION**

- Mr. Berhanu is a licensed Professional Engineer (Mechanical Engineering)
- Certified Energy Manager (CEM)
- Qualified Commissioning Provider (QCP)
- Leadership in Energy and Environmental Design (LEED-AP) Accredited Professional
- Certified Measurement and Verification Professional (CMVP)
- Certified Demand Side Manager (CDSM)
- Type III technician for refrigerants, Environmental Protection Agency (EPA) certified

### **EMPLOYMENT HISTORY (14 YEARS PROFESSIONAL EXPERIENCE)**

- SDV/ACCI (2002-2003, 2006- present)
- EBA Associates (1993-Present)
- ADM Associates (1991-1993)
- AEL Associates (1990-1991)

### **SELECTED PROJECT EXPERIENCE**

**California Energy Commission (CEC) SDV/ACCI.** Project Scope: Currently Mr. Behrhnanu is the principal engineer responsible for the design and installation of end use and weather monitoring systems for three model homes. He has worked on the proper functioning of the already installed monitoring systems, assisted in the establishment of communication of the monitoring system and display panel with a remote server, performed final functional test on the monitoring system and display panel prior to the opening of the Zero Energy Homes. Further projects include a re-commissioning project that involved end-use monitoring, site survey and analysis for the Integrated Design of Small Commercial HVAC Systems project of CEC. Mr. Berhanu was also responsible for conducting an energy audit for San Bernardino Valley Community College Planetarium and Gym buildings, Crafton Community College Bookstore and Gym building. He has collected data, interviewed stakeholders, analyzed results and prepared final reports and recommendations.

**Southern California Edison (SCE) / RLW Analytics, Inc.** Project Scope: Energy analysis and site survey for the Non Residential New Construction Building Efficiency Assessment Study project of 2004/2005 managed by SCE for SDG&E and SCE territories.

**Sacramento Municipal Utility District / Hagler Bailly.** Project Scope: Surveys and DOE-2 simulations of 166 new construction residential buildings for the study of impact evaluation of a new construction residential program.

**Pacific Gas and Electric Company / Davis Energy Group.** Project / EBA Scope: Evaluation of the performance of geosource heat pumps for proto type commercial and residential buildings.

**San Diego Gas & Electric/Architectural Energy Corporation.** Project Scope: Evaluation and monitoring of the performance of cool roof technology for Cool Roof Performance Monitoring Project.

## **RELEVANT EXPERTISE AND QUALIFICATIONS**

### ***Energy modeling, specifically energy engineering principles and simple engineering models***

Certified Energy Manager (CEM), Over 15 years experience in energy efficiency projects that include energy simulation, audit, measurement and verification and retro-commissioning experience. Mr. Berhanu is also a PE, QxCP, CDSM, CMVP, LEEDS-AP. He has used extensively Title 24 standards in developing baseline for both residential and commercial facilities as well as ASHRAE standards. Mr. Berhanu has modeled and surveyed all types of commercial and residential buildings. He has employed diversity factors, standby loads as well as flue gas factors for hooded appliances when developing the equipment load and associated schedule. He is familiar with effects of building envelop in terms of U-value, heat capacity and absorption coefficient like in cool roof. He is also familiar with the performance curves (part load and temperature) of HVAC systems that include chillers in the mechanical side.

Mr. Berhanu has completed utility evaluation projects for commercial, residential and industrial facilities. He has also performed utility incentive calculations for Kaiser Hospital, UC-Irvine SS Bldg, etc., implementing energy simulation programs. He has also performed energy analysis for CEC Energy Partnership program. In addition, he has completed over one hundred Office of Public School Construction (former OLA) energy analysis projects that include life cycle cost analysis and benchmarking with utility history of demand and energy use for retrofit applications. On the measurement and verification side, he was involved on retro-commissioning projects for small and large HVAC systems.

### ***Collection and analysis of metering data***

Mr. Berhanu installed data loggers/hobos for monitoring pumps, chillers, boilers, HVAC, Lighting and motor performance, Ambient Conditions. He performed air distribution flow measurement, fluke metering of voltage and currents, economizer testing, refrigerant charging, also EPA certified. He has attended a course at the University of Wisconsin on Testing, Adjusting and Balancing applicable to air and water systems. He also completed a course by the same university for certified training for accredited commissioning process provider. Mr. Berhanu has also obtained QxCP certification—sample projects include:

**Architectural Energy Corporation** Retro-commissioning project of Westin Hotel in Palm Desert that involved detailed end-use monitoring of chillers, boilers, pumps, AH performance.

**Integrated Design of Small Commercial HVAC Systems project of CEC (2001/2002). Sacramento Municipal Utility District / Davis Energy Group** Project / EBA Scope: DOE-2 Analysis, site survey and extraction and screening of monitored data for geosource Heat Pump Monitoring Project.

**Pacific Gas and Electric Company / Davis Energy Group** Project / EBA Scope: Evaluation of the performance of geosource heat pumps for proto type commercial and residential buildings.

**California Energy Commission (CEC)SDV/ACCI:** Project / EBA Scope: A retro-commissioning project that involved end-use monitoring, site survey and analysis for the Integrated Design of Small Commercial HVAC Systems project of CEC (2001/2002).

**California Energy Commission (CEC)SDV/ACCI:** PIER Project: Zero Energy New Homes. Was the engineer responsible for the design and installation of end use and weather monitoring system for three model homes. Worked on the proper functioning of the already installed monitoring systems, assisted in the establishment of communication of the monitoring system and display panel with a remote server,

performed final functional test on the monitoring system and display panel prior to the opening of the Zero Energy Homes.

**San Diego Gas & Electric/Architectural Energy Corporation.** Project / EBA Scope: Evaluation and monitoring of the performance of cool roof technology for Cool Roof Performance Monitoring Project.

### ***Energy test instruments and procedures***

Mr. Berhanu installed data loggers/hobos for monitoring HVAC, Lighting and motor performance, Ambient Conditions. He performed air distribution flow measurement, fluke metering of voltage and currents, economizer testing, refrigerant charging, also EPA certified. He also attended a course at the University of Wisconsin on Testing, Adjusting and Balancing applicable to air and water systems. Mr. Berhanu also completed a course by the same university for certified training for accredited commissioning process provider. Mr. Berhanu has also obtained QxCP certification.

### ***Energy audit fieldwork***

Mr. Berhanu performed numerous energy audits and analysis of several industrial facilities for utility evaluation programs that also include process loads. He simulated energy uses and demands as well as associated savings utilizing efficient and VSD motors as well efficient lighting and controls, HVAC systems, compressors as well as chilled chillers controls for process loads. Sites analyzed include Los Angeles Times Printing Facility, Amgen Biotech Manufacturing Site, Callaway Golf Manufacturing, GreenTech Manufacturing as well as various Central Plants.

Mr. Berhanu has completed over a hundred energy audits that entail simulation models for various commercial, residential, industrial and institutional sites. The sites surveyed include commercial storages, light commercials and industrials, hotels, hospitals, high tech companies, biotech facilities, central plants of large universities, hospital and aero space industries. He has also surveyed fast food and sit down restaurants, convention centers, refrigeration warehouse and groceries, etc. Mr. Berhanu has also employed calibration of the building energy use and demand with monitored data and/or benchmarked with utility history on retrofit projects when applicable. Questionnaires regarding the operation of the facility (lighting, HVAC, Equipment, interior Shades, etc) were conducted with site contact to simulate the actual operation of the facility. He has also used building mechanical, electrical and architectural plans for takeoffs and also contacted the applicable designer when appropriate.

### ***Experience with pre and post measurement and analysis, specifically collecting pre-data***

Mr. Berhanu has completed over one hundred simulation models for various commercial, residential, industrial and institutional sites. Among the buildings simulated includes hotels, hospitals, high tech companies, bio tech facilities, central plants of large universities, hospitals and an aero space company. He also modeled fast food and sit down restaurants, convention centers, refrigeration warehouses and groceries, etc. The models also incorporated various energy conservation measures related to building envelope as well as lighting & HVAC systems and their associated controls. T-24 and utility baseline are employed to evaluate the associated savings related to the energy use and demand. The recommended measures are simulated and run combined to account and evaluate the interactive effects. Mr. Berhanu has also employed calibration with monitored data and benchmarking with utility history on retrofit projects when applicable. Questionnaires regarding the operation of the facility (lighting, HVAC, Equipment, interior Shades, etc) are also conducted ahead in most of these models to simulate the actual operation of the facility.

Mr. Berhanu performed Evaluation of Small Commercial Project with package AC units that include refrigerant charging, flow measurement, temperature hobos, economizer test, fluke meter current and kW measurements of HVAC systems as well as installation of data loggers and current transformers. He has



also completed energy audit, modeling and remotely monitored performance of residential ground source heat pumps installed on various locations.



## Section 4: Team Member Rates and Hours Matrix

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The ECONorthwest team member rates and hours matrix is contained in the Excel workbook “ECONW Section 4.xls” included with our proposal.

Note that we have assumed a 20-month evaluation period (starting approximately May 2008 and running through January 2010) and the total evaluation budget of \$839,000 to determine the average hours of availability for each staff member. Average hours were determined based on staff availability over the study period and considering the overall budget cap. This was done under the assumption that – in order for the CPUC to make a valid comparison across firms – all bidding firms would need to develop a similar set of parameters in terms of assuming a consistent number of study months (20) and setting hours for staff that still fall within the total evaluation budget of \$839,000.

If these assumptions are NOT correct (for example, if other firms assume something other than a 20-month study period, or the budget cap is exceeded), then we would appreciate the opportunity to submit additional information regarding staff availability that is consistent with the parameters used by other firms submitting proposals.



# Section 5: Sample Evaluation Plans Cover Sheet

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## **RFP No. 07 PS 5734**

*Contractors to Conduct Evaluation, Measurement, and Verification of the California Investor Owned Utilities' Embedded Energy in Water Pilot Programs*

### **Prime Contractor:**

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### **Subcontractors:**

SBW Consulting, Inc  
Pacific Institute  
Population Research Systems  
SDV / ACCI (DVBE)



# Section 6: Sample Evaluation Plans

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## GENERAL EVALUATION ISSUES

From our current understanding of the Pilot programs, we believe that there are several overarching evaluation issues that will apply to each of the individual programs. We discuss these general issues first and then address issues specific to the five programs selected for the sample evaluation plans.

### *Pacific Institute Water to Air Model*

Our proposed evaluation strategy utilizes the Pacific Institute's Water to Air Model for developing estimates of embedded energy savings in water for each of the Pilot programs. The Water to Air model provides estimates of embedded energy savings from information on the allocation and energy intensity of water supply among different sources. The model allows for five different of water sources and conveyance methods: groundwater, local surface water, reclamation, imported, and desalination. The model also allows for a mix of nine potential energy generation sources (e.g., natural gas, coal, or a default value of California Grid Mix) for each water source, which are ultimately used in the calculation of embedded energy savings. Given this information and data on the amount of water saved at the end use site, the annual embedded energy savings is estimated based on a variety of model parameters that can be tailored to match an individual program or end use scenario.

The Water to Air Model has several advantages for use in the Pilot programs evaluation. First, the Water to Air model already has an established and tested system for determining embedded energy savings for a wide range of different water supply and treatment mixes, as well as different sources of electricity generation. This provides the flexibility to use the model in virtually all the program areas covered in the Pilot study. The model structure itself is also very flexible so it can be modified or expanded to address additional research needs.

### *Coordination with Other Water/Energy Studies and Analysis Tools*

As the preceding discussion suggests, the existing Water to Air model combined with the expertise of the Pacific Institute provides a solid starting point for addressing the Pilot studies. In addition, the Water to Air model will allow us to take an established framework and expand it to meet the needs of the Pilot evaluation and develop savings estimates that can be used in other applications such as the upcoming Statewide study being managed by LBNL (as discussed at the bidders conference). In addition, we will adapt the structure of the Water to Air model to be consistent with the E3 calculator, so that it can become an improved embedded energy sub-model for the E3 calculator. Not only will this allow the embedded energy savings values to be used in the E3 calculator, but the additional water savings and emissions reduction impacts estimates produced by the Water to Air model can be used in the cost-effectiveness tests done in the E3 calculator.

In addition to using the existing Water to Air Model to develop annual embedded energy savings estimates, we will work with the Pacific Institute to enhance and expand the model so that it can also provide information that will feed directly into other related studies. In particular, we will expand the model to shape energy and water savings to provide estimates at the seasonal and diurnal level. As discussed at the bidders conference, the Statewide study is being designed to provide seasonal and diurnal embedded energy estimates for use in 15 regions. To coordinate the Pilot evaluations, we will “shape” the



impacts (for both end use water impacts and embedded energy impacts) to be consistent with the Statewide study using the same 15 regions and time period definitions.

### ***Net Impacts***

Our intent is to develop the estimates of net savings at the program level much in the manner that the evaluation plans have been developed for many of the energy impact evaluation contract groups. From these program level net impacts, rigorous impacts of the embedded energy will also be derived. What we propose is to develop a clear protocol for developing estimates at the measure and program level, for both end-use water consumption and embedded energy at the water agency level. For water conservation measures, the customer decision processes are similar to those followed for energy conservation measures and therefore many of the evaluation techniques developed for energy can be applied to water. In particular, a large amount of resources on the energy side have been devoted to developing state-of-the-art survey and analysis for the self-report free ridership methodology. Since the customer decision processes are similar for purchasing energy and water conservation measures, we anticipate using the same self-report method for the Pilot program water measures.

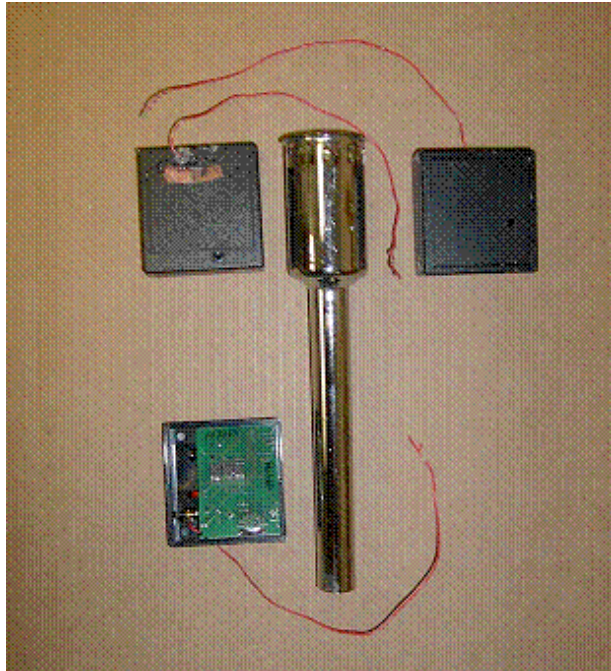
To develop program and measure-level impacts, we need to model and measure site-level water and energy impacts for a sample of projects representative of each program. From each sample, impacts will be estimated and then extrapolated to the program population. Some Pilot programs are focusing on coldwater efficiency measures, so the site-level energy impacts may be small. However, these programs also may involve conducting audits to determine other water conservation measure opportunities, which may result in a wider variety of water conservation strategies influenced by the program. Additionally, even coldwater measures may have energy use impacts related to pumping or other mechanical actions (e.g., washing machines).

### ***Site Metering***

All of the sample evaluation plans will involve water metering at a sample of customer sites and the sampling strategy will be designed to follow the Sampling and Uncertainty Protocol in the Evaluation Protocols designed for energy conservation programs. At a minimum, we will develop the on-site metering sample for these sites to achieve a 90/10 relative precision across all of the Pilot programs. Given the overall evaluation budget and the cost of installing on-site meters, it is unlikely that we will be able to achieve a 90/10 relative precision for each individual Pilot program at the measure or program level.

For each program where metering is involved, we will be using the meters to collect both pre-installation and post-installation data. The pre-installation data will be used to establish the program baseline against which the post-installation metered consumption data will be compared.

SBW has experience in installing a wide range of water metering devices that will be utilized in the Pilot program evaluations. The figures below show a sample of metering devices that will be used for this evaluation. Figure 1 shows a metering device developed by SBW that can be used on smaller appliances, such as high efficiency toilets. The second photo shows the meter installed on an HET. Figure 2 shows a conventional accumulating flow meter installed in line on an efficient pre-rinse spray valve. SBW has experience in creating and installing these types of metering devices for a wide range of water equipment and end uses.



**Figure 1: Small Meter Device Components and Meter Installed on HET**



**Figure 2: Meter Installed on Pre-Rinse Valve**

### ***Guidelines for Future Evaluations***

We propose that the evaluations of the Pilot programs be structured so that the evaluation findings can be used to develop guidelines and possibly formal protocols for future evaluations involving embedded energy savings of water conservation programs. To accomplish this, we are proposing evaluation plans for the Pilot programs that are as consistent as possible with the Evaluation Protocols already adopted for the energy impact evaluations. In addition to the program-specific evaluation results for gross and net water and energy savings (both at the end use and embedded), this evaluation will also produce a set of specific recommendations on standard evaluation procedures. These recommendations could then serve as the basis for establishing guidelines and (eventually) evaluation protocols for all water program evaluations that involve determining embedded energy savings.

### ***Project Management***

The management plan and expected division of labor will be the same for each of the Pilot program evaluations. ECONorthwest will serve as the primary contact with the CPUC throughout this evaluation. ECONorthwest and SBW will work together to develop the overall evaluation plan and the EM&V plans for each of the Pilot programs. ECONorthwest will manage and organize all customer data received for each program, while SBW will manage the on-site metering and any associated fieldwork. ECONorthwest will work with John Stevenson and PRS to develop all the phone survey instruments, in-depth interview guides, and recruiting scripts. ECONorthwest and SBW will work with Pacific Institute to enhance the Water to Air model to match the needs of this evaluation and develop estimates of embedded energy impacts for each Pilot program. ECONorthwest will analyze all survey data and develop the self-reported free ridership estimates. ECONorthwest and SBW will work together to develop all the final gross and net water and embedded energy impacts for each Pilot program. ECONorthwest will be the lead author of the final evaluation report, with assistance as needed from SBW and Pacific Institute.

## **SAMPLE EVALUATION PLANS**

The following are our proposed sample evaluation plans. In each case, we propose an evaluation plan that will provide equal and consistent treatment of each program to determine both energy and water savings at the end use level. As discussed above, the evaluation methods have been designed to be as consistent as possible with the energy impact evaluation Protocols.

### **SCE LOW INCOME DIRECT INSTALL HET (MULTIFAMILY)**

From the RFP, the SCE Low Income Direct Install program involves a partnership with MWD and one or more of its member agencies to deliver the direct installation of High Efficiency Toilets (HETs) for multi-family households in low income areas within mutual MWD and SCE service territories. SCE will leverage existing LIEE contractors, local government partnership programs, and MWD member water agencies to identify and reach target customers. Incentives for the HETs will be provided by SCE and each of the MWD water agencies that choose to participate in this program. Additionally, SCE's Direct Install HET program will focus exclusively on multi-family residences and has a goal of installing approximately 550 toilets.

We will begin each of the evaluations by developing an evaluation research plan that will be submitted to the Energy Division for review and comment. We anticipate that the development of the research plan will follow the general process used for the energy impact evaluation research plans. We will also make the evaluation plan available for public review (similar to the Energy impact evaluation plans) if desired

by Energy Division. We will respond to all comments received in writing and will address all comments in the final research plan.

After we have developed the final evaluation plan, we will begin recruiting participants from the SCE Low Income Direct Install HET program for the data collection evaluation tasks. Given this participant population, we propose recruiting customers for pre-installation metering. During the recruitment phase, we will also collect basic demographic data that will be used in the impact estimation (e.g., number of people in the household, number of people home during the day, number of bathrooms, etc.). The exact number of customers that can be metered will be determined as we develop the evaluation plan, based on the number of participants and the amount of total evaluation resources that can be allocated to this program.

For the metered sample, we will install the meter on the existing toilet(s) and collect three to five weeks of pre-installation water usage data for each customer. This information will be used to determine baseline usage at the customer and measure level. Once the pre-installation data have been collected, the HET will be installed and the meter will be used to collect post-installation water usage data. The post-installation data collection is also expected to last three to five weeks.

In addition to the approach described above, we will also consider a hybrid meter approach that can be used to reduce sampling error, but at the expense of measurement error. For example, one approach with the HET would be to take in-situ measurements of pre/post flow rates (old toilet vs. new toilet) for a larger sample of installations and then use a sub-sample to measure the flow duration (data collected for one to two weeks both pre and post installation).

In addition to hybrid designs, the CPUC may want to consider doing technology studies that cross Pilot program boundaries, such as a study of HET. To accomplish this, the evaluation would develop per unit savings values from a smaller sample of metered sites and then perform much less expensive site verification visits just to confirm for a relatively large sample that the measure is installed and operational. A possibility here would be to target four to six of the Pilot program measures that account for the largest savings across all programs and to do a sample of metered sites per measure type across all programs. This would then be combined with a larger sample of verification work and self-report free ridership estimates to determine net realized savings from these measures. We will discuss the advantages of the various metering options with the CPUC before developing the final strategy in the evaluation plan.

In addition to the metered sample, we will conduct a short interview with a sample of 100 customers to collect additional information needed to calculate net realized impacts. These surveys will be used to collect demographic information and additional information regarding water use that may be useful in the impact analysis (e.g., information on household size, number of people at home during the day, etc.). We will also collect additional information regarding any important changes that may have occurred during the study period that would affect water use (e.g., remodeling, vacations or extended absences). This information will be used to help adjust our model estimates to account for changes in water usage that are external to the program measures. Finally, we will use the survey to recruit a sample of 40 for on-site visits to verify that the HET is installed. Both the survey sample of 100 and on-site verification sample of 40 are large enough to achieve a relative precision level of 90/10 for this program. The final sample sizes for these activities will be determined as we develop the overall evaluation plan.

In addition to demographic information, the customer surveys will also be used to collect information on potential free ridership. These questions will focus on the likelihood that the customer would have purchased an HET if the program were not available. We will attempt to use a self-report free ridership question battery that mirrors, as much as possible, the one being developed in the Net to Gross working group as part of the CPUC's Residential Programs impact evaluations. However, given the slightly



different nature of the HET program design, we realize that some modifications to the self-report questions may be needed.

The results of this analysis will be estimates of gross and net water savings impacts at the customer and program level. The water impacts will then be used in the Pacific Institute Water to Air model to determine gross and net savings estimates for the embedded energy for the water agency serving these customers. This will be done both for water supply, as well as water treatment, for agencies serving the participating customers. As discussed above, we propose modifying the Water to Air model so that the embedded energy impacts are provided at the annual and diurnal level for the 15 regions that will be covered in the upcoming Statewide study. Additionally, the embedded results will also be developed for use as a component of the E3 calculator to calculate cost effectiveness.

The final results for this evaluation will be a written report that clearly documents all the evaluation activities and analysis results. This will include detailed estimates of both gross and net impacts for both end use water consumption and for the embedded energy savings resulting from the HET. In addition to the impact estimates, the evaluation will also serve as means to test and refine the evaluation guidelines that we propose, helping to establish guidelines for future evaluations of similar programs. To this end, part of the deliverable for this evaluation will include recommendations for future evaluations of programs involving embedded energy savings. Specific recommendations will be made regarding what type of data should be tracked for these programs for use in the impact evaluation.

Information that we will need for to evaluation this program includes the following:

1. Customer contact data (name, phone, address)
2. Electricity generation mix for utility serving the customer (for use in the Water to Air model)
3. Customer electricity and water usage account data for both the pre-installation and post-installation data
4. Electricity and gas usage data for the water agencies serving the participating customers (both supply and waste water treatment).
5. Electricity and gas account data for the waste water treatment facilities serving the participating customers.

Most of the evaluation tasks will be done in parallel with the same tasks for the other Pilot programs. The major evaluation activities and expected duration are as follows:

1. Develop final evaluation research plan (four weeks)
2. Recruit participants for pre-metering with existing toilets (52 weeks, throughout the Pilot implementation phase)
3. Collect three to five weeks of pre-installation data per customer (52 weeks, throughout the Pilot implementation phase)
4. Install meters on HET and collect three to five weeks of post-installation data (52-57 weeks, throughout the Pilot period)

5. Analyze pre-data and post-data to determine gross and net water impacts (12 weeks, after final metered data are collected following implementation phase)
6. Estimate embedded energy savings using Pacific Institute model (four weeks)
7. Evaluation Report (four weeks)

The biggest potential for delays is related to recruiting customers for the metered sample. Since we want to collect pre-installation data, customers need to be recruited prior to installing the HET. In some cases, the customer may decide after he/she has been recruited for the metered sample not to follow through with having the HET installed. Because of these potential dropouts, we need to over sample to account for this. Dropouts may be less of an issue with multi-family residences if the building owners are the ones making the decisions on whether or not to install the measures, however.

## **SCE LAKE ARROWHEAD WATER CONSERVATION**

As described in the RFP, the Lake Arrowhead Water Conservation Program involves a partnership between SCE, SCG, and the Lake Arrowhead Community Services District (LACSD) to deliver indoor water-conserving devices and outdoor landscaping retrofits. The program targets the 1,000 largest residential water customers as identified by the LACSD. Measures promoted by the program include high efficiency toilets (HET), low-flow shower heads, sink aerators, ET/Smart controllers, and sprinkler head retrofits. SCE and SCG will co-fund LACSD's proposed program to expand the number of homes that can be served. LACSD will identify candidate homes, coordinate delivery of the program, and provide funding to purchase the water conserving devices (with contributions from SCE and SCG to complete the purchase of the devices). The customer will be responsible for installation, and LACSD will verify that eligible customers have installed the equipment.

The evaluation plan for the Lake Arrowhead Water Conservation program will be similar in structure to that proposed for the SCE Low Income Direct Install HET program discussed above, with the same major evaluation activities. As with all the Pilot programs, the evaluation will begin by developing a detailed evaluation plan that will be submitted to the Energy Division for review and comment. We will work closely with the Energy Division in the development of the evaluation plans for all Pilot programs and anticipate that this task will be very much a collaborative effort between our team and the Energy Division. We will also make the evaluation plan available for public review if desired by Energy Division. We will respond to all comments received in writing and will address all comments in the final research plan.

After we have developed the final evaluation plan, we will begin recruiting participants from the Lake Arrowhead Water Conservation program for the data collection evaluation tasks. One of the first tasks will be to recruit a sample of customers for pre-installation metering. During the recruitment phase, we will also collect basic demographic data that will be used in the impact estimation (e.g., number of people in the household, number of people home during the day, number of bathrooms, etc.).

For the metered sample, we will install the meter on all measures (indoor and outdoor) at the customer site and collect three to five weeks of pre-installation water usage data. This information will be used to determine baseline usage at the customer and measure level. Once the pre-installation data have been collected, the measures will be installed and the meter will be used to collect three to five weeks of post-installation water usage data.

Note that the Lake Arrowhead Conservation program (in conjunction with the SCE Low Income Direct Install HET program and other Pilot programs promoting the same measures) is one that the CPUC may

want to consider for doing a cross-program study for common measures such as HETs. If this approach is adopted, then the metered sites for HETs and any other common measures would be pooled with metered data from the other Pilot program evaluations to create a larger sample that will enable more precise estimates of per unit savings. This savings estimate would then be used for all programs that cover the same measure.

In addition to the metered sample, we will conduct a short survey with a sample of 100 customers to collect additional information needed to calculate net realized impacts. These surveys will be used to collect demographic information and additional information regarding water use that may be useful in the impact analysis (e.g., information on household size, number of people at home during the day, etc.). We will also collect additional information regarding any important changes that may have occurred during the study period that would affect water use (e.g., remodeling, vacations or extended absences). This information will be used to help adjust our model estimates to account for changes in water usage that are external to the program measures. Finally, we will use the survey to recruit a sample of 40 for on-site visits to verify that the measures are installed. The on-site verifications will be somewhat more important for the Lake Arrowhead program, as the program design calls for having the customers (rather than contractors) install the measures, which may result in somewhat lower installation rates. The phone survey sample of 100 is large enough to achieve a 90/10 relative precision level for this program. Given that the on-site verifications will involve multiple measures per site, the proposed sample size of 40 should also be large enough to achieve a 90/10 relative precision level for the program. (Please note that, although the LACSD is listed in the RFP as verifying the installations, it may be worthwhile for the evaluation team to also do a sample of on-site verifications to determine retention rates and correct installation and operation.)

As with all the Pilot programs, the customer survey will also be used to collect information on potential free ridership. These questions will focus on the likelihood that the customer would have purchased and installed the conservation measures in absence of the Lake Arrowhead Water Conservation program. The self-report questions will be asked for each measure installed by the customer so that measure level free ridership estimates can be developed. As with all the Pilot programs, we will use a self-report question battery that is as similar as possible to the one developed for the Residential Program energy impact evaluations, as the decision processes at the customer level will be very similar.

The results of this analysis will be estimates of gross and net water savings impacts at the customer and program level. The water impacts will then be used in the Pacific Institute Water to Air model to determine gross and net savings estimates for the embedded energy for the water agency serving these customers. This will be done both for water supply, as well as water treatment, for agencies serving the participating customers. Once we have modified the Water to Air model, we will be able to take the end use savings to estimate the embedded energy impacts at the annual and diurnal level for the 15 regions that will be covered in the upcoming Statewide study. The embedded results will also be developed for use as a component of the E3 calculator to calculate cost effectiveness for this program.

The final results for this evaluation will be a written report that clearly documents all the evaluation activities and analysis results. This will include detailed estimates of both gross and net impacts for both end use water consumption and for the embedded energy savings resulting from all measures promoted by the Lake Arrowhead Water Conservation program. As with all the Pilot program evaluations, part of the evaluation deliverables will include recommendations for future evaluations of programs involving embedded energy savings. Specific recommendations will be made regarding what type of data should be tracked for these programs for use in the impact evaluation.

Information that we will need to evaluate this program includes the following:



1. Customer contact data (name, phone, address)
2. Electricity generation mix for utility serving the customer (for use in the Water to Air model)
3. Customer electricity and water usage account data for both the pre-installation and post-installation data
4. Electricity and gas usage data for the water agencies serving the participating customers (both supply and waste water treatment).
5. Electricity and gas account data for the waste water treatment facilities serving the participating customers.

The major evaluation activities and expected duration are as described below. Most of these tasks will be done in parallel with the same tasks for the other Pilot programs. Specific activities include:

1. Develop final evaluation research plan (four weeks)
2. Recruit participants for pre-metering with existing equipment (52 weeks, throughout the Pilot implementation phase)
3. Collect three to five weeks of pre-installation data per customer (52 weeks, throughout the Pilot implementation phase)
4. Install meters on measures and collect three to five weeks of post-installation data (52-57 weeks, throughout the Pilot period)
5. Analyze pre-data and post-data to determine gross and net water impacts (12 weeks, after final metered data are collected following implementation phase)
6. Estimate embedded energy savings using the modified Water to Air model (four weeks)
7. Evaluation Report (four weeks)

As with the other programs, the biggest potential for delays is related to recruiting customers for the metered sample. Since we want to collect pre-installation data, customers need to be recruited prior to installing the measures. As with any of these recruitment efforts where we want to collect pre-installation metered data, there is the risk that the customer may decide after he/she has been recruited for the metered sample to not follow-through with having the measures installed. Because of these potential dropouts, we need to over-sample to account for attrition.

Timing will also be of essence here to recruit customers for the summer months so that we can collect both pre-installation and post-installation data for sprinkler head retrofits during the peak watering season.

## **PG&E LARGE COMMERCIAL CUSTOMER**

As described in the RFP, the Large Commercial Customer program is actually a suite of three distinct program elements. The first targets process improvements in food processing industrial facilities, such as improvements in cleaning and sanitation, cooling towers, and water recycling and re-use. The second element targets possible water savings improvements at wineries. The third element targets a specific technology found in the Hospitality sector: the use of ozone treatment as a replacement for traditional

laundry treatment. All three of these program elements are to be pursued in partnership with EBMUD and SCWA. The first two focus on food processing and wineries, and are based on water efficiency audits to be conducted at 12 participating facilities. The number and type of specific measures to be implemented can only be known as these audits are completed and the participating customers approve the implementation of specific audit recommendations. The third element, targeting the specific ozone technology, will be implemented at 50 facilities.

As with all the Pilot programs, the evaluation will begin by developing a detailed evaluation plan that will be submitted to the Energy Division for review and comment. We will work closely with the Energy Division in the development of the evaluation plans for all Pilot programs and anticipate that this task will be very much a collaborative effort between our team and the Energy Division. We will also make the evaluation plan available for public review (similar to the Energy impact evaluation plans) if desired by Energy Division. We will respond to all comments received in writing and will address all comments in the final research plan.

As indicated in the RFP, all three program elements will be treated as comprising a single program and we will develop a plan to achieve reliable estimates of total water savings and embedded energy savings, and as appropriate, energy end use savings for the entire program. We will rely on an optimally allocated, size-stratified sample design to achieve this end. The sample will be stratified by the expected size of the water savings for each measure implemented by this program. The allocation among strata will appropriately account for the expected large variation in the size of savings among the various participants and implemented measures. We will implement a pre/post measurement design in determining the end use water and energy savings for each sampled measure. To implement such a design, we must obtain (from the each program element) information about the proposed work at each participating site prior to the measures being implemented. We assume that each program element will make a proposal to each of the participating customers after it has been determined that specific measures are applicable and cost-effective, and that at that time the program will make a commitment to provide financial support for the improvement. We will obtain a copy of these proposals from the program at the time that they are issued to the customer. If appears likely that the proposal will be accepted, we will assign each measure to a strata and make it available for sampling. The sampling will be at fixed intervals within each strata, keeping the probability of selection constant within a strata.

If a measure is sampled, we will begin work immediately so as not to lose the opportunity to obtain pre period data. Our first task will be to develop a site-specific M&V plan. The plan will specify the data to be collected in the pre and post period, and the analysis to be performed in estimating end use water and, if appropriate, end use energy savings. SBW's engineers have developed more than 200 such plans for a wide variety of water and energy savings projects over the last 10 years. Many of these are directly applicable to the improvements that we expect to find in these programs. In particular, we have developed and implemented such plans for two prior ozone retrofits.

The major elements of the M&V report for one of these projects are summarized in the following sections; the report summary serves to illustrate how we create an implement site and measure specific approaches to the estimation of water savings. In addition, it exemplifies the types of site-specific M&V plans and reports the CPUC could expect in our evaluation of this program.

### **Efficiency Improvement**

This project resulted in the installation of an ozone generator in the laundry room. The use of ozone for washing dramatically reduces the hot water and chemicals required. Minimizing chemicals reduced the number of rinses necessary for each load of laundry. The program estimated that this measure would save approximately 1,295 CCF annually.

## **Baseline Equipment and Operation**

The laundry room at this facility contains three washers, two Uniwash50 (50-pound capacity) and one Uniwash85 (85-pound capacity) commercial washing machines. Each machine runs a mix of loads, which are generally classified as "food and beverage" and "sheets and towels." Previously, food and beverage loads went through two wash cycles and three rinse cycles, while sheet and towel loads went through a single wash cycle and three rinse cycles. It typically took about 45 minutes to process a load, although this time varied depending on the type of cycle. According to the housekeeping manager, these machines are in use nearly continuously during the two daily shifts (6 a.m. to 12 a.m.). Annual laundry production is estimated at 1,200,000 lbs.

## **Installed Equipment and Operation**

The equipment installed for this measure consisted of an ozone generator and associated distribution and control hardware. The application predicted that by reducing the rinse requirement, the amount of water needed per load would fall by 40 percent. Wash cycle times presumably would be shortened as well.

## **M&V Method**

To estimate annual laundry production, we relied on results from a one-week test by hotel staff, during which time they weighed all laundry loads for that period. These weights, combined with hotel occupancy data, yielded the number of pounds of laundry per occupied room per day in the baseline case. Data collected for a similar hotel proved that laundry production closely correlates to occupancy rates. We therefore multiplied the laundry pounds per room per day by one year's worth of occupancy data to estimate the annual pounds of laundry processed.

We determined average pre- and post-installation normalized water use for both sizes of machines. For the 85-lb. washer and one of the two 50-lb. washers, we metered both hot and cold water usage for 37 days before installation and 30 days after installation. We sampled one of the two 50-lb. machines, since laundry room personnel stated that the load compositions for the two units were similar. For each monitored machine, the average water usage per pound of laundry equaled the total hot and cold water usage during the metering period, divided by the number of pounds processed during that time (the latter we calculated by multiplying the occupancy rate by the number of rooms and the measured pounds/room/day figure). We determined efficient normalized water use in a similar fashion after the ozone system was installed. By subtracting the average gallons per pound for the efficient setup from the baseline setup, we calculated the average water savings per pound. Annual water savings were the average water savings per pound, multiplied by the annual number of pounds of laundry.

At the same time we measured water usage, we also monitored electrical current to all three washers to count loads. We originally meant to use these load counts to extrapolate to annual laundry production, but the daily and monthly occupancy data the hotel provided gave us a better means to do that.

## **Data Collection**

Key data and their sources included:

Water flow: We installed totalizing in-line flow meters on the hot and cold water supply lines to one of two 50-lb. washers, and the 85-lb. washer. For these two washers, we measured total water volumes for 37 days during the baseline period, and 30 days during the post-installation period.

Laundry production: The building engineer performed these measurements over one week. These measurements found that the average daily laundry load when the hotel was 100 percent occupied was 4,333 lbs/day.

Occupancy rates: Hotel personnel provided actual monthly occupancy rates. They also supplied daily occupancy rates during the evaluation water metering period.

Number of loads: We installed a Pace Pocket Logger with a 100A current transducer on one leg of the electrical circuit for each of the three washing machines. These loggers were configured to record average current at one-minute intervals for about 15 days in both the baseline and post-installation periods. These periods occurred simultaneously with the water flow measurements.

## **Gross Savings Analysis**

Hotel occupancy records show that during the one-year, pre-installation period the average occupancy rate was 81.4 percent. Multiplying this rate by 243 rooms and 365 days/year yields 72,175 occupied room-days during the year. This figure, multiplied by the 17.8 lbs of laundry per occupied room per day (that the hotel measured during their one-week test), results in an estimated annual laundry production of 1,286,972 lbs/year.

We applied the normalized laundry rate of 17.8 lbs/room/day to the daily occupancy rates during the monitoring periods to estimate laundry production during these periods. Pre- and post-installation metering period laundry production figures were 109,322 lbs. and 81,244 lbs., respectively. Corresponding water flowmeter readings were taken for the same period and gallons of water used for the two monitored washers were calculated. Washer 1 (50 lbs.) showed poor results: The total gallons used per day increased by six percent, even though the number of loads per day dropped by 11 percent. Therefore, the average gallons per load for Washer 1 increased by 20 percent. Results for Washer 3 (85 lbs.) are much more in line with expectations. The gallons per day dropped by 30 percent, and the gallons per load by 19 percent. Both washers showed significant increases in cold water usage from the pre- to the post-installation period, which are offset by large declines in hot water use. Load counts from the current loggers show that loads were divided very evenly throughout the monitoring period between the three washers, so that each washer processed between 32 and 34 percent of the total number of loads.

Combining these results with laundry production data yields the savings for the project. Normalized water usage before installation of the ozone system was 0.50 gallons/lb. of cold water and 0.88 gallons/lb. of hot water, for a total of 1.38 gallons/lb. overall. After installation, normalized cold and hot water usage were 0.83 and 0.50 gallons/lb. respectively, for a total of 1.33 gallons/lb overall. Primarily because of the poor results for Washer 1, the increase in cold water usage nearly offsets the decrease in hot water usage, so that the overall water savings are only 0.05 gallons/lb, a reduction of about three percent.

On an annual basis, projected water use goes from 2,371 to 2,288 CCF/year, a savings of 83 CCF/year. Interestingly, cold water usage actually increases from 854 to 1,427 CCF/year (67 percent increase), while the hot water usage drops from 1,517 to 861 CCF/year (43 percent decrease).

The evaluated annual gross water savings of 83 CCF/year are just six percent of the program estimate of 1,295 CCF/year. The primary reason for this large shortfall is the poor performance of 50-lb. Washer 1 (and by extension Washer 2), which is using about 20 percent more water per load now than before installation. This almost completely offsets the savings from 85-lb. Washer 3. From conversations with the ozone system vendor, two reasons seem likely explanations for the small savings:

- Shortly after the ozone system was installed, the laundry chemical vendor reprogrammed the machines to run an unnecessary extra rinse. The ozone system vendor has since instructed the chemical vendor to eliminate this, and is awaiting confirmation that this had indeed occurred.
- Hotel laundry room staff operated one of the machines improperly, so that each load was getting washed twice.

Related to these reasons is the fact that the application overstated the amount of water required per pound of laundry in the baseline case. The actual amount of water used was about half what the application assumed. Had the baseline water use actually been 2.5 gallons/lb., then the ozone system savings would have been 47.0 percent, instead of 3.4 percent.

As with all the Pilot programs, a customer survey will also be used to collect information on potential free ridership. These questions will focus on the likelihood that the customer would have installed the sampled measure in the absence of the program. We will use a self-report question battery that is as similar as possible to the one developed for the Large CI energy impact evaluations, as the decision processes at the customer level will be very similar.

The results of this analysis will be estimates of gross and net water savings impacts at the customer and program level. The water impacts will then be used in the Pacific Institute Water to Air model to determine gross and net savings estimates for the embedded energy for the water agency serving these customers. This will be done both for water supply, as well as water treatment, for agencies serving the participating customers. Once we have modified the Water to Air model, we will be able to take the end use savings to estimate the embedded energy impacts at the annual and diurnal level for the 15 regions that will be covered in the upcoming Statewide study. The embedded results will also be developed for use as a component of the E3 calculator to calculate cost-effectiveness for this program.

The final results for this evaluation will be a written report that clearly documents all the evaluation activities and analysis results. This will include detailed estimates of both gross and net impacts for both end use water consumption and for the embedded energy savings resulting from all measures implemented under these programs. As with all the Pilot program evaluations, part of the evaluation deliverables will include recommendations for future evaluations of programs involving embedded energy savings. (Details on the analysis timeline and potential for evaluation delays are the same as discussed in the other evaluation plans and therefore are not repeated here due to space limitations.)

## **SDG&E RECYCLED WATER**

The SDG&E Recycled Water program will target users that can switch from a potable water source to a recycled water use that uses less energy. The Water Authority and its member agencies will identify sites with completed retrofit plans that will allow customers to switch from potable water usage to recycled water, and where it can be implemented immediately. Water savings will be documented through water meter readings. SDG&E and SDCWA will provide co-funding for these projects and the program is expected to save 2,100 million gallons of water.

Given the general description of this program, it appears likely that these projects will vary considerably across customers and that site-specific EM&V plans will be needed based on the customer and equipment retrofits completed. As with all the other sample evaluation plans, we will discuss these issues with the Energy Division and then develop an evaluation plan for this program. We will also make the evaluation plan available for public review and will respond to all comments received in writing prior to producing the final research plan.

The RFP states that water savings will be documented from water meter readings. However, it is unclear from this if information on both the volumes of potable water and recycled water will be available for each customer and if this is something that will be measured by the Pilot program. If this information is being collected by the program, then we will use these data directly in our evaluation analysis. If information on both potable and recycled usage volumes is not being collected, then we will need to recruit customers for the evaluation to install meters in order to capture data on recycled water usage.

In addition to information on water volumes, we will also conduct a short survey with participating customers. The program description states that the program will target those customers with completed retrofit plans. In some cases, it may be that the customer is doing the retrofits as part of a larger remodel that involves an expansion in production, which in turn may increase water usage in the post period. In these cases, the baseline would need to be estimated assuming the water consumption of the new equipment without the recycled water option. There is also the potential that the retrofit may include new equipment that is more water efficient, which will also need to be incorporated into the baseline calculations. If the new equipment also causes a change in production schedules that results in water usage shifting to off-peak periods, then this will need to be addressed in the analysis as we develop diurnal usage patterns for use in the Water to Air model.

As with all the Pilot programs, we will also be asking these customers a battery of questions designed to get at self-reported free ridership, and these questions will be designed to be as consistent as possible to those being used in the current energy impact evaluations. Since the program description in the RFP states that the program is targeting those customers with completed retrofit plans, it is unclear if these plans were instigated by the Recycled Water Program, an energy efficiency program, or by the customer independent of any energy or water conservation program. Additional questions will be added to the survey to identify and disentangle these various possible influences.

The results of this customer analysis will be estimates of gross and net recycled water usage that are attributable to the program. The gross and net recycled water usage will be used in the Pacific Institute Water to Air model to determine gross and net savings estimates for the embedded energy for the water agency serving these customers. This will be done both for water supply and water treatment for agencies serving the participating customers. The enhanced Water to Air model developed in this evaluation will be used here to provide embedded energy impacts at the annual and diurnal level for the 15 regions that will be covered in the upcoming Statewide study. As with the other Pilot program evaluation results, the embedded results will also be developed for use as a component of the E3 calculator to calculate cost effectiveness.

The final results for this evaluation will be a written report that clearly documents all the evaluation activities and analysis results. This will include detailed estimates of both gross and net impacts for embedded energy savings resulting from all measures implemented through the program. The evaluation report will also include recommendations for future evaluations of programs involving embedded energy savings. For the recycled water program, recommendations will also be developed on the proper baseline definitions for those customers that do retrofits that also involve expanding production. Specific recommendations will also be made regarding what type of data should be tracked for these programs for use in the impact evaluation.

The major evaluation activities and expected duration are as described below. Specific activities include:

1. Develop final evaluation research plan (four weeks)
2. Recruit participants for analysis sample (52 weeks, throughout the Pilot implementation phase)



3. Conduct customer interviews to collect information on changes in production capacity, changes in timing of water usage, self-report free-ridership (52-57 weeks, throughout the Pilot period)
4. Analyze changes in water consumption to determine gross and net shift to recycled water and adjusting to account for any changes in production capacity (eight weeks)
5. Estimate embedded energy savings using the modified Water to Air model (four weeks)
6. Evaluation Report (four weeks)

The biggest potential for delays in this program evaluation would be if there were any difficulty with accessing water billing information for both the pre period and post period.

## **SCG CLAWA/EMWD GAS PUMP TESTING**

This program takes a different approach to achieving savings in embedded energy. All the other pilot programs achieve savings in embedded energy by reducing the quantity of water used as various end uses. This program attacks the problem by attempting to reduce the amount of energy needed to supply the water to these end uses. Specifically this partnership between SCG and CLAWA/EMWD will target efficiency improvements in gas-fired pumping facilities used in the water supply system. Testing will be carried out at 150 pumping facilities to identify ways to improve the efficiency of both the pump and engine. The estimated maintenance/improvement based upon the test results of the pump/engines will include: (1) improvements based on aging/worn equipment (e.g. impellor replacements), (2) changes in hydraulic conditions within the well itself and pumping apparatus, and (3) opportunities to maximize efficiency through technology/improvements in both the engines and the pumps.

As with all the Pilot programs, the evaluation will begin by developing a detailed evaluation plan that will be submitted to the Energy Division for review and comment. We will work closely with the Energy Division in the development of the evaluation plans for all Pilot programs and anticipate that this task will be very much a collaborative effort between our team and the Energy Division. We will also make the evaluation plan available for public review (similar to the Energy impact evaluation plans) if desired by Energy Division. We will respond to all comments received in writing and will address all comments in the final research plan.

We will develop a plan to achieve reliable estimates of total energy savings. We will rely on an optimally allocated, size-stratified sample design to achieve this end. The sample will be stratified by the expected size of the energy savings for each pumping project implemented by this program. The allocation among strata will appropriately account for the expected large variation in the size of savings among the various participating facilities. We will implement a pre/post measurement design in determining the energy savings for each sampled project. To implement such a design, we must obtain (from the program) information about the proposed work at each participating site prior to the measures being implemented. We assume that the program will make a proposal to each of the participating customers after it has been determined that specific measures are applicable and cost-effective, and that at that time the program will make a commitment to provide financial support for the improvement. We will obtain a copy of these proposals from the program at the time that they are issued to each facility, and if it appears likely that the proposal will be accepted we will assign each project to a strata and make it available for sampling. The sampling will be at fixed intervals within each strata, keeping the probability of selection constant within a strata.

If a project is sampled, we will begin work immediately so as not to lose the opportunity to obtain pre period data. Our first task will be to develop a site-specific M&V plan. The plan will specify the data to be collected in the pre and post period, and the analysis to be performed in estimating end use water and,



if appropriate, end use energy savings. SBW's engineers have developed more than 200 such plans for a wide variety of water and energy savings projects over the last 10 years. Many of these are directly applicable to the improvements that we expect to find in these programs. Although we have not had an opportunity in the past to analyze a gas-driven pumping improvement project, we believe it will have some similarities to a project we evaluated for improving electrical pumping at a water treatment facility. Provided below is a summary of that analysis. We will develop similar site-specific analyses for each of the sampled projects.

## **Efficiency Improvements**

This facility is a water filtration plant that provides about 60 percent of the total water needed annually for an Oregon community and operates on demand to fill city water reservoirs. The following pumping efficiency improvements were analyzed:

- Implement an alternative raw water mixing/chemical treatment scheme, so that the existing throttling valve can be opened as wide as possible.
- Maximize running Low Lift Pump #2 instead of #1, and High Service Pump #5 instead of #6.
- Whenever possible, run Low Lift Pump #2 at low speed.

## **Baseline Equipment and Operation**

Generally, the plant processes water for about eight hours per day, six days per week during the winter, and processes water for about 10 to 12 hours per day, seven days per week during the summer. The plant usually processes at flow rates between 12 and 15 mgd depending on water demand.

The main electric equipment consists of these two pumping systems:

Raw water system: Seven lift pumps bring raw water into the plant from the river. One of the two 50-hp low lift pumps (LLP-1 and LLP-2) moves water into basins, where one of four intermediate pumps (IP-3 through IP-6, 60-150hp) transfers raw water into the plant. Simultaneously, a 150-hp intermediate pump, IP-7, moves water directly from the river to the treatment plant. Downstream of the pumps is a partially closed throttling valve. Turbulence from this valve helps mix the water treatment chemicals that are injected at this point.

High service system: Six pumps deliver processed water to city reservoirs. These pumps include HSP-1, -2, and -4, which range in size from 125-250 hp. These three are not used as frequently as HSP-5, -6, and -7. The latter range in size from 400-500 hp. HSP-7 has a variable-speed drive and runs continuously during processing to provide trim control, while HSP-5 and HSP-6 alternate running.

## **Savings Analysis Methods**

Energy savings were estimated as follows for each of the efficiency improvements:

- Alternative raw water mixing/chemical treatment scheme: We performed plant tests to collect one-minute power measurements with the throttling valve in both the throttled and wide open position. We calculated the reduction in brake horsepower that resulted from opening the valve. Using the only pump curve (for IP-7) that was available and applicable, we predicted the flow increase related to the power reduction, then made adjustments to account for new pressure drops from a static mixer. This allowed us to estimate the net reduction in the normalized power ratio

(bhp/gpm). This latter figure, applied to estimated annual raw water flow, yielded estimated savings.

- Maximize running Low Lift Pump #2: We installed C180 true RMS power data loggers to collect 15-minute data for twelve days on all major pumps. We obtained total raw water flow hourly trend data from city staff (these flow data were based on an in-line flowmeter on the raw water line. Although this meter may be up to 10 percent inaccurate, we assumed for the analysis that any errors were consistent across all data points). We calculated water pumping efficiencies (measured kW/trended mgd) for each hour during the measurement period, then determined the average efficiency for each observed pumping scheme. We used the calculated efficiency differences to estimate savings from improved pump sequencing and staging.
- Run Low Lift Pump #2 at low speed: From the same measured data sources as described above, we calculated hourly power requirements for IP-7 and for the remaining raw water pumps. From IP-7 pump curve, we determined corresponding flow, and subtracted this from the trended total raw water flow to obtain the flow for the remaining raw water pumps. We calculated kW/mgd efficiency ratios for IP-7 and the remaining pumps, and multiplied the difference by the applicable flowrate and annual hours of operation to estimate savings.

As with all the Pilot programs, a customer survey will also be used to collect information on potential free ridership. These questions will focus on the likelihood that the customer would have installed the sampled measure in the absence of the program. We will use a self-report question battery that is as similar as possible to the one developed for the Large CI energy impact evaluations, as the decision processes at the customer level will be very similar.

As this program seeks to reduce the energy consumption of the water supply system, the results of this impact evaluation will be direct estimates of gross and net embedded energy savings at the customer and program level.

The final results for this evaluation will be a written report that clearly documents all the evaluation activities and analysis results. This will include detailed estimates of both gross and net impacts for embedded energy savings resulting from all measures implemented under these programs. As with all the Pilot program evaluations, part of the evaluation deliverables will include recommendations for future evaluations of programs involving embedded energy savings. Specific recommendations will be made regarding what type of data should be tracked for these programs for use in the impact evaluation.

The major evaluation activities and expected duration are as described below and are the same as described for each of the other sample evaluation plans. Most of these tasks will be done in parallel with the same tasks for the other Pilot programs. Specific activities include:

7. Develop final evaluation research plan (four weeks)
8. Recruit participants for pre-data collection with existing equipment (52 weeks, throughout the Pilot implementation phase)
9. Collect three to five weeks of pre-installation data (52 weeks, throughout the Pilot implementation phase)
10. Collect three to five weeks of post-installation data (52-57 weeks, throughout the Pilot period)

11. Analyze pre-data and post-data to determine gross and net water impacts (12 weeks, after final metered data are collected following implementation phase)
12. Estimate embedded energy savings using the modified Water to Air model (four weeks)
13. Evaluation Report (four weeks).

As discussed previously, the biggest potential for delays is related to recruiting customers for the sample. As with any of these recruitment efforts where we want to collect pre-installation data, there is the risk that the customer may decide after he/she has been recruited for the metered sample to not follow through with having the measures installed. Because of these potential dropouts, we need to over-sample to account for possible attrition.

# **Attachment 1: Attachment Check List**

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## **Attachment 2: Certification Sheet**

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# **Attachment 3: Disabled Veteran Business Enterprise Participation Form**

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# **Attachment 5: Conflict of Interest Disclosure**

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